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BOSTON UNIVERSITY

Technical Note 100

A PRELIMINARY REPORT ON THE CLIMATOLOGY OF THE ARCTIC SLOPE OF ALASKA, WITH PARTICULAR REFERENCE TO THE POSSIBILITY OF MAKING CLIMATOLOGICAL ESTIMATES FROM THE DISTRIBUTION OF VEGETATION

John N. Conover

June 1953

OPTICAL
RESEARCH
LABORATORY

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by

John H. Conover

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Contract AF 33(038) - 13615

Monitoring Agency:
Photographic Reconnaissance Laboratory
Wright Air Development Center

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ABSTRACT

In an effort to obtain climatological estimates from the distribution of natural vegetation of the Arctic coastal plain, as seen on aerial photographs, six weather stations were set up and operated during the summer of 1952 in the Umiat, Alaska, region. Continuous measurements of solar radiation, temperatures from 6 feet above the ground to 2 feet below the surface, black-bulb temperatures, wind and precipitation were obtained in and around an alder clump at Umiat. Continuous recordings of black-bulb temperatures, root zone temperatures and wind speed were obtained from five stations along a 1/4 mile north-south transect having exposures ranging from a 40-degree slope facing south, covered with alders, to a barren 15-degree slope facing north.

The macroclimate of the surrounding area is discussed and it is suggested that during summer a zone at about the 2,000-foot level along the north slope of the Brooks Range may experience higher average temperatures than above and below that level simply because the top of the Arctic air mass normally intersects the mountains at about that level.

At this time only a part of the data has been analyzed but large differences in the duration of root zone temperatures above 40 degrees F are found between sites. An arbitrary method of calculating relative growth from the black-bulb temperatures also revealed significant differences between the sites. Wind effects, in the form of wind-blown brush and the killing of new growth, were observed and could probably be deduced from aerial photographs.

Recommendations for future field work and analysis are included.

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PREFACE

This project, one phase of which is discussed in this report, was proposed by the Directorate of Intelligence, Department of the Air Force, as a result of a prototype study conducted by that office and reported in detail in "Review and Evaluation of the Application of Aerial Photographic Interpretation of Vegetation Types to Military Intelligence of Arctic and Subarctic Areas, Parts I, II, and III." Requirements for the project, summarized from the above-mentioned report, were set forth in a letter, dated 25 July 1950, from the Director of Research and Development, Hdqtrs., USAF (AFDRD-EQ-3) to the Commanding General, Air Materiel Command. The portions of this letter which relate to the purpose and objectives of the program are quoted below:

1. There is an urgent need for research and development to improve photographic interpretation techniques in order to bring about increased knowledge of potential areas over which we might be compelled to conduct air operations. One of these techniques is the development of photointerpretation keys which can be applied to analogous areas in the USSR. The Directorate of Intelligence, this Headquarters, has investigated the application of the interpretation of vegetation types in Alaska as a method of approach toward the development of analogous-area keys for arctic and subarctic regions. This investigation has established that a research program of this nature promises to pay dividends by improving the interpretation techniques and consequently increasing our knowledge obtainable through aerial photography. It is therefore directed that a research project be initiated for the development of aerial photographic keys of the vegetation of Alaska.

2. The following research objectives are furnished as a guide for the establishment of this program:

   a. To contribute toward the development of an analogous-area key applicable to the arctic and subarctic regions in the USSR.

   b. To aid in the selection of sites for air bases and air facilities through the use of aerial photography.

   c. To aid in the operational planning of search and rescue through the use of aerial photography.

   d. To aid in the selection of sites through the use of aerial photography where adequate water supplies may be obtained.

e. To aid in the production of climatological estimates from the distribution of natural vegetation, especially in areas where weather stations are sparse or weather data are not available.

f. To assess the trafficability of areas from the vegetation cover as shown on aerial photographs.

g. To provide training material and techniques of arctic and subarctic areas for both elementary and advanced training of photointerpreters.

h. To aid in the selection of engineering sites and engineering materials through the use of aerial photography.

i. To aid in the location of defense positions for ground troops, especially as these positions are related to types of soil, depth of water table, and presence or absence of permafrost.

j. To aid in the study of the distribution of insect pests as related to natural vegetation and the methods of eradication and/or control of these insects.

k. To aid in the training for and the accomplishment of aerial observation and air map sketching.

l. To contribute in general toward the technique of aerial photographic interpretation through the development of a PI key in vegetation in Alaska as associated with other factors such as soil, drainage, and permafrost.

m. To investigate some of the newer techniques such as color photography, infrared photography, use of film positives and negatives as applied to the interpretation of natural vegetation as shown on aerial photographs."

The requirements apply to all of Alaska with the exception of the Aleutian Islands, the Alaskan Peninsula, the coastal region just north of the Gulf of Alaska, and the Alexander Archipelago. Moreover, the study is to be completed in a minimum period of time. An added requirement has been laid down---the development of a procedure for procuring information for preparing valid aerial keys applicable to large areas.

Work on the project was initiated at this laboratory in 1951 under contract W33-038-ac-14075 and has been continued under the present contract. The project is under the immediate supervision of Dr. Franklin C. Erickson, Chairman of the

Geography Department and Professor of Geography at Boston University, assisted by Charles M. Matthews, Research Associate in the Physical Research Laboratories.

This particular report is one of a series in which the 1952 field investigations will be summarized. The objectives of the over-all program are presented in Technical Note 99, "The Over-all Objectives of the Alaskan Photointerpretation Keys Project and an Outline of the Program Proposed for the 1952 Field Season."

The author of this report, John H. Conover, is a member of the staff (Research Fellow and Technical Manager) of the Harvard University Blue Hill Meteorological Observatory, Milton, Mass. He has been associated with Boston University as a consultant on the climatological phase of this project.

Duncan E. Macdonald, Director
Physical Research Laboratories

I. INTRODUCTION

The climatological phase of this project has been guided by the following objective: "To aid in the production of climatological estimates from the distribution of natural vegetation, especially in areas where weather stations are sparse or weather data not available"

The "climatological estimates" are desired in the usual numberical form, such as temperature, wind, precipitation, etc., rather than vegetal zones which are often considered as climatological zones, but are obviously related to other factors such as soil acidity, soil texture and water drainage. The separation of one factor, or group of factors, from others affecting vegetational growth is extremely difficult. Furthermore, the complexity of the problem is greatly increased in the Arctic where the soil is underlain with permafrost and the temperature gradient from the soil surface downward is far greater than that found at more southern latitudes.

Numerous references and papers, which are listed at the end of this report, were studied Those outside the laboratory personally consulted were:

Professor Hugh M. Raup, Harvard Forest, Petersham, Mass.
Mr. Philmore, formerly of the Arnold Arboretum, Boston, Mass., now Rickert Nurseries, Morrisville, Pennsylvania
Dr C W Thornthwaite, Johns Hopkins University and Seabrook Farms, New Jersey

Due to the time required for the purchase and delivery of new instruments it was necessary to set up an observation program quickly to insure that all purchased items would be delivered in time. However, but for a few exceptions, adequate instrumentation was achieved. The greatest drawback proved to be a delay in leaving for Alaska with the result that almost all the measurements were started after the growing season had commenced

II. MACROCLIMATE OF THE AREA

The cool, cloudy, weather, characteristic of the growing season in the Umiat area is a result of the proximity of the cold Arctic Sea to the north and the Brooks Range to the south. The Sea provides the cold dampness while the Brooks Range to the south acts as a barrier to warmer air masses.

The Climatological Summary prepared by the US Weather Bureau for Umiat based on 3 to 5 years of observations is reproduced as Table A-1 in the appendix. This summary illustrates the general climatic elements.

A. Synoptic Weather Map Picture

The coldness of the Arctic Sea causes an atmospheric pressure distribution which averages higher over the sea than over the land. This is especially true during the summer when the land is free of snow. Such a pressure pattern results in a northeasterly flow of air over the Umiat area. Cold air banks up against the north side of the Brooks Range and remains in that position most of the time. It is believed that the cold air averages about 2000 feet deep over the Umiat area. To the north, over Barrow, radio sondes show the depth to average about 3000 feet during the summer. The mean summer (June-July-August) positions of the warm and cold air masses are shown in Figure 1 in the form of a cross section from Fairbanks to Pt. Barrow. The combination of the Brooks Range barrier and the persistent cold air cushion to the north practically excludes the possibility of storms entering from the south. In winter an occasional storm enters from the Bering Sea and passes northeastward, but only the most intense storms are able to scour out the cold air allowing the warm air mass to be felt at the ground. In summer most storms that approach from the southwest are characterized by the

passage of an upper level pressure trough; surface weather is marked by a shift in wind from southeasterly to westerly, but without temperature or dew point changes.

Throughout the period of long summer days in Alaska, a thermal low develops to the south of the Brooks Range. Heating in the low levels frequently causes the temperature lapse rates to be convectively unstable. The resulting convective clouds can occasionally be seen from Umiat as they dissipate crossing northward over the mountains fifty miles to the south. Upon rare occasions, when the pressure gradient decreases between Umiat and the Arctic coast the cool easterlies cease and the sky clears. This is followed by a rapid warming of the tundra surface, often to above 100°F, while shelter temperature may reach 80°F. Under these conditions showers are likely with an occasional thunderstorm.

From time to time weak lows drift eastward to the north; the trailing cold front, which crosses the area, causes a temperature and dew point drop as it passes. Northwesterly winds, which follow the cold front, must flow slightly upslope and often produce light rain or drizzle with heavy low cloudiness.

B. Cloudiness and Visibility

Cloudiness over the region averages high. During June, at the start of the growing season, the average cloud cover is 7/10 (10/10 equals a complete cover); this is followed by an average of 8/10 for July and 9/10 for August. Most of these clouds are low, of the stratus type, which form in the top of the cold air mass.

Visibility is either excellent or low due to fog or precipitation. Intermediate visibilities resulting from varying degrees of what is usually classified as haze appear to be unknown in the region. Fog and the usual situation under which it occurs is discussed in the section under humidity.

C. Precipitation

Precipitation types and their relative frequency from June through August may be classified into four types. The number of cases of each type and the average amounts received for the period June 1 - Sept 1, 1952 are shown below:

Type	Upper trough	Cold front	Shower	From stratus or stratocumulus clouds
Number	7	4	3	30 days out of 69 (June 24-Sept 1)
Precip. (in.)	0.21	0.10	0.10	Trace/day

D. Temperature

The meterological averages shown in the climatological summary illustrate the low level of temperature. In winter along the Arctic Slope it is known that the extreme cold is not as severe as south of the Brooks Range where pockets of cold air develop and the wind does not stir for days.

It is possible that the lowest wintertime temperatures on the continent would be found in high-altitude basins (3,000 - 4,000 feet, MSL) on the northern side of the Brooks Range. It is conceivable that in such a basin having mountains on the east, south and west sides and a narrow outlet on the north that the air could cool to exceptionally low temperatures due to strong nocturnal radiation over a period of several clear days. Average temperatures remain low throughout the year at Umiat in contrast to high seasonal changes south of the Range. The number of consecutive days when the vegetation, as determined by the black-bulb thermometer, remains above 32° varies locally, but at Umiat it was only 28 in 1952.

From the schematic cross section of prevailing summer air masses shown in Figure 1, it is suspected that average temperatures in that season do not

decrease steadily as one travels southward and higher from Umiat to the crest of the Brooks Range. In spite of the fact that the depth of cold air over the Arctic Slope varies from day to day and is occasionally wiped out completely, there probably exists somewhere along the north slope, perhaps around 2000 feet, a zone where the average temperatures are lower both upslope and downslope. Thus, in traveling from Umiat southward and uphill, temperatures should fall slightly, due to higher elevations, until the level of the top of the cold air is reached; at this level temperatures should rise and not until the transition zone has been passed will temperatures again fall with increasing altitude.

E. Humidity

Relative humidity averages high throughout the year. During the summer it is higher than in winter. The actual water content of the air, however, is exceedingly low during the cold winter and moderately low throughout the growing season. But of greater interest is the large diurnal variation in the dew point or vapor pressure during the summer. This is shown in Figure 2. Apparently a transfer of water from the wet ground to the air takes place as the air is warmed through the morning and early afternoon. As convection begins, the water vapor in the shallow layer (roughly 2000 feet thick) is dispersed upward, temporarily lowering the vapor pressure at the shelter level. This humidifies the air mass to a point where stratocumulus clouds will form after a relatively small amount of cooling (by convective lifting). Toward evening, as the ground cools, evaporation decreases but the shelter level air continues to dry out, presumably as vapor is dispersed upward and condensed in the form of clouds. Near midnight, on the average, fog begins to form at ground level and soon afterward a little light drizzle falls from the thickening stratus. Thus moisture is evaporated from the wet surfaces in the morning, pumped into the lower atmosphere by convection

6.

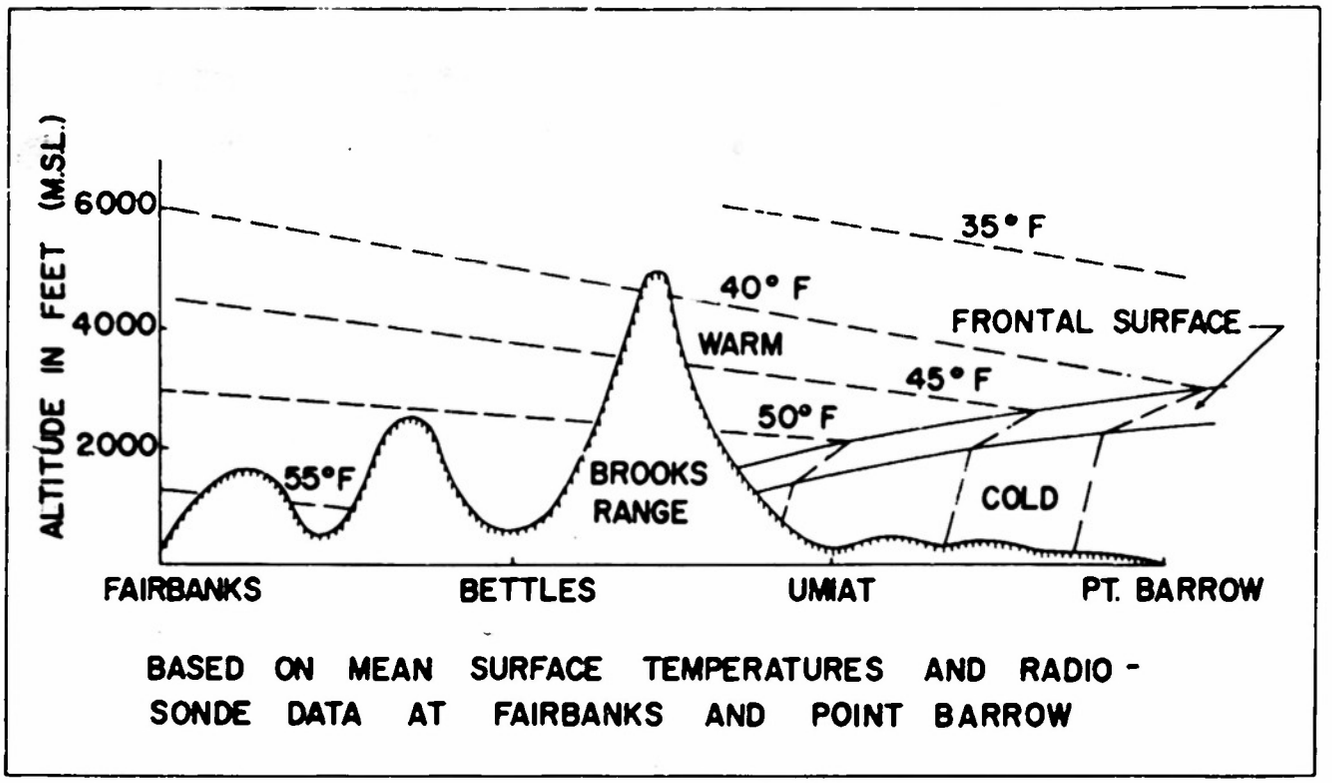

Figure 1. Atmospheric Cross Section Showing Mean Summer Isotherms and Average Position of the Frontal Surface Marking the Top of the Arctic Air Mass

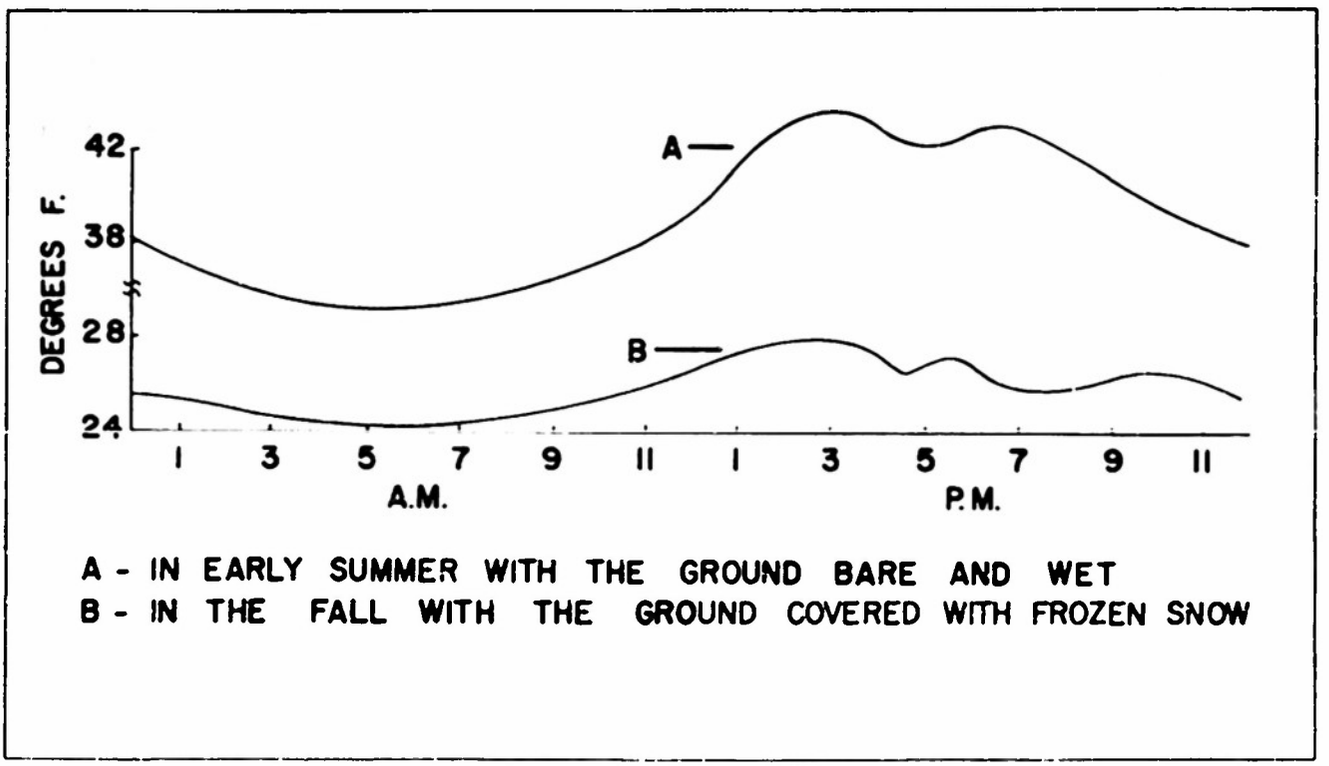

Figure 2. Average Diurnal Variation in the Dew Point at 6 Feet at Umiat from Seven Characteristic Days

through the afternoon and partially condensed out during the early morning hours. The net exchange is apparently outgoing, since the soil definitely dries out during the summer.

In contrast to the summertime diurnal vapor pressure curve, a curve for a typical period in September, when the ground was covered with one inch of frozen snow, is also shown in Figure 2. The ranges are 0.8 mb over a frozen surface vs 2.8 mb over wet soil.

Before observing this sequence of events, it was suspected that condensation might be an important supplement to the meager precipitation of the area. It was planned to blot condensation from a copper plate using filter paper and to determine the amount of condensate from careful weighings of the paper before and after the blotting. However, no condensation was found during the author's brief stay (June 18-28) simply because the ground was always warmer than the dew point. Observations, however, were not made between midnight and 7 A.M. In spite of the underlying cold soil the surface remained warm apparently from continuous incoming solar energy. Toward the fall season, after the sun sets each day, condensation probably increases, but the amounts are certainly small, at least up until the end of August.

F. Wind

In contrast to the long periods of calm found in the central valleys of Alaska the Arctic Slope is almost constantly swept by wind. Although the annual average, at about the 25-foot level over Umiat, is only 8 miles per hour its effects are shown on the vegetation. These effects will be discussed later. The prevailing winds at the station are west in the winter and east in the summer.

During the winter, drifting granular snow tends to smooth out the landscape,

leaving the hummocks bare and the hollows filled. Generally, the land is not completely snow covered during most of the winter, due to the light snowfalls and nearly continuous drifting.

G. Summary

From the above we see that the general climatic conditions during the growing season are those of light but frequent precipitation, moderate temperature, high relative humidity and much cloudiness. Winds are moderate and predominantly from the east. During winter, snowfall is light and it drifts continually, tending to smooth out the terrain leaving the hummocks exposed while the vegetation on the sides of depressions remains protected.

The stability of the weather from one season to the next and the comparison of the 1952 summer weather with the average has not yet been investigated. However, this is planned, using the Pt. Barrow and Umiat Weather Bureau data.

In a general way the macroclimate of the Umiat area during both summer and winter should be similar to areas of the USSR that are oriented in the same way in respect to topography. In summer a thermal low also developes over the USSR, and since a chain of mountains may be found not far from the coast, it is reasonable to assume that the temperature distribution from the coastline to the mountains is similar to that outlined above for the analogous area north of the Brooks Range. Storm tracks, however, are different, but the resulting weather should be quite similar to that over the Alaskan Arctic Slope.

III. AREAS STUDIED

Data were collected from two areas; the first area which contained one station, was about 300 feet east of the US Weather Bureau and Civil Aeronautics building at Umiat, hereafter identified as the Umiat Base Station (115-volt, 60-cycle power was available at this station). The second area was along a south-north line which crossed the first range of hills about two miles NNE of Umiat. Five stations, hereafter designated as Sites 1, 2, 3, 4, and 5, were located along this line.

The clustering of stations was not only advantageous from the standpoint of servicing, which was required daily at the Umiat Base and weekly at the Sites, but simplified the study since some of the climatological elements could be assumed as practically equal at all the stations.

A. The Umiat Base Station

The Umiat Base station (part of which is shown in Figure 6a) was centered around a clump of alders which were growing from a raised polygon about 8 feet in diameter and 8 to 10 inches above the surrounding level of ground. The age of a similar appearing alder in a nearby clump was over 30 years, although its cross section was only about 1.25 inches. This area was characterized by other raised polygons and alder clumps spaced from 25 to 50 feet apart. The ground between polygons was so soggy with water in late June that the soles of one's shoes were always wet after walking across what appeared to be dry grass. Further details of the vegetation and soils at this station will be discussed in the reports covering other phases of the project.

Northwest of the alder clump a small 4 by 4-foot plywood shack was erected to house a Brown Electronik recorder, portable instruments and tools. A standard

US Weather Bureau cotton region type thermometer shelter (shelter dimensions: approximately 30-inches high, 30-inches wide and 20-inches deep) was placed roughly 30 feet SW of the alder clump. Approximately 15 feet SW of the alder clump a rigid camera platform was erected, from which frequent stereo photos, which could be used to show growth at the site, were made. Arrangement of the equipment is sketched in Figure 3.

B. Sites 1, 2, 3, 4, and 5

Sites 1 through 5 lay on a line running approximately S-N over the first range of hills NNE of Umiat. Their locations are marked on the aerial photo in Figure 4. The area was selected for the following reasons: a) certain climatological factors, such as solar radiation on a horizontal surface, could be assumed as equal to that measured at Umiat Base; b) the sites possessed a wide range of aspect, or exposure, ranging from a 40-degree slope facing south to a 15-degree slope facing north; c) soil studies and some botanical work had been done over the same area during the summer of 1951; and d) lastly, but of prime importance, the sites could be reached without excessive difficulty, even if it became necessary to walk from the Umiat camp.

The sites are located schematically in respect to slope and separation in Figure 5. Photographs of the sites, made in late summer, are shown in Figure 6. The vegetational zones at the sites have been tentatively identified (by Mr. Robert Riederman, an Ecological Aide) from photographs. They are as follows:

Site 1: Colluvial slope-salix-alnus complex
Site 2: Same as site 1
Site 3: Medium-Heath-Birch Niggerhead
Site 4: Medium-Shrub-Heath Niggerhead
Shrubs are alders, birch and willow (all dwarfed); or

Medium-Alder-Shrub-Heath-Niggerhead
Site 5: Low sphagnum niggerhead (Birch-sphagnum-alder mounds scattered throughout stand)

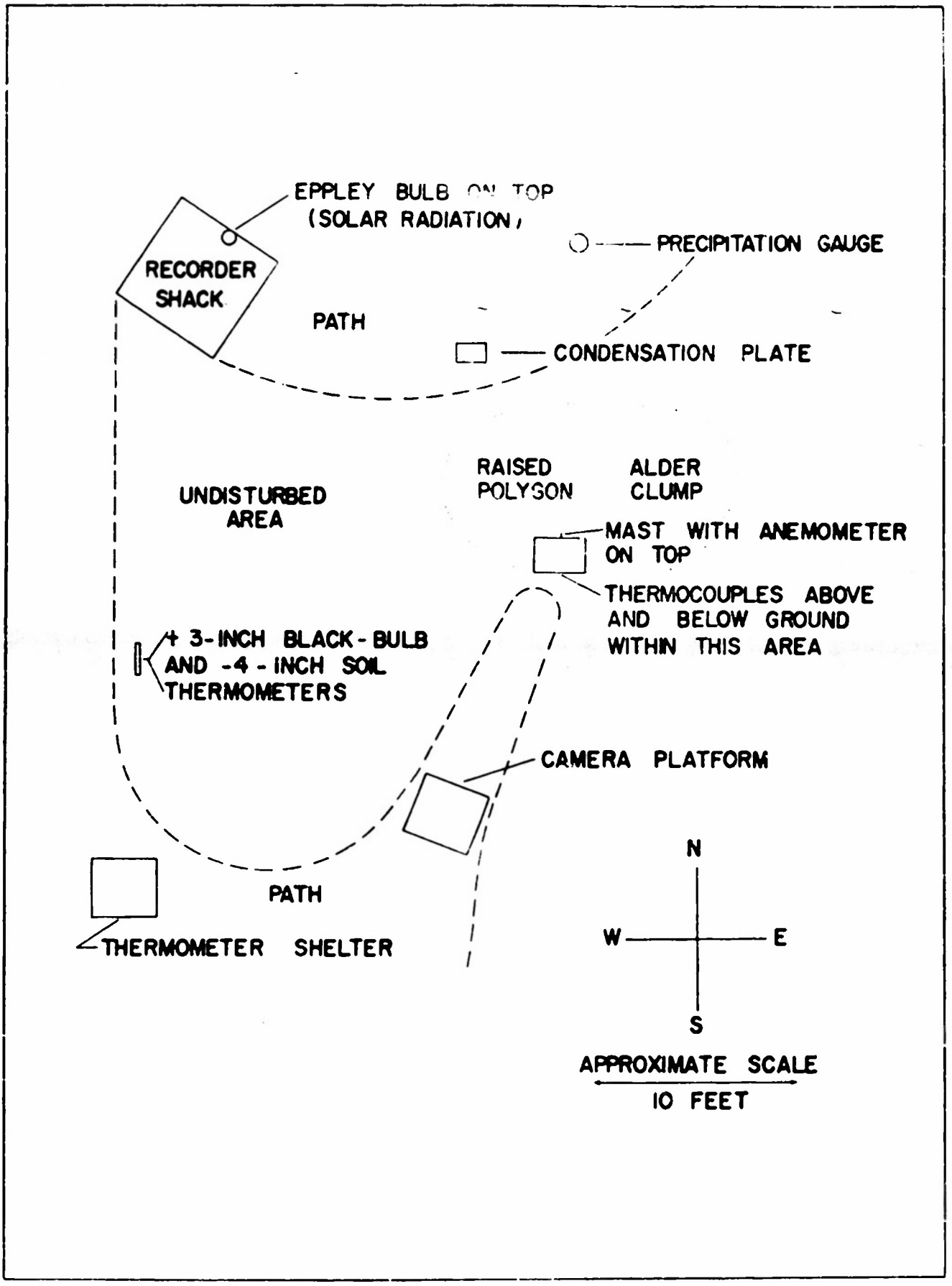

Figure 3. Arrangement of Meteorological Equipment [illegible] at Base Station

Figure 4. Aerial Photograph of Umiat Base and Sites 1-5

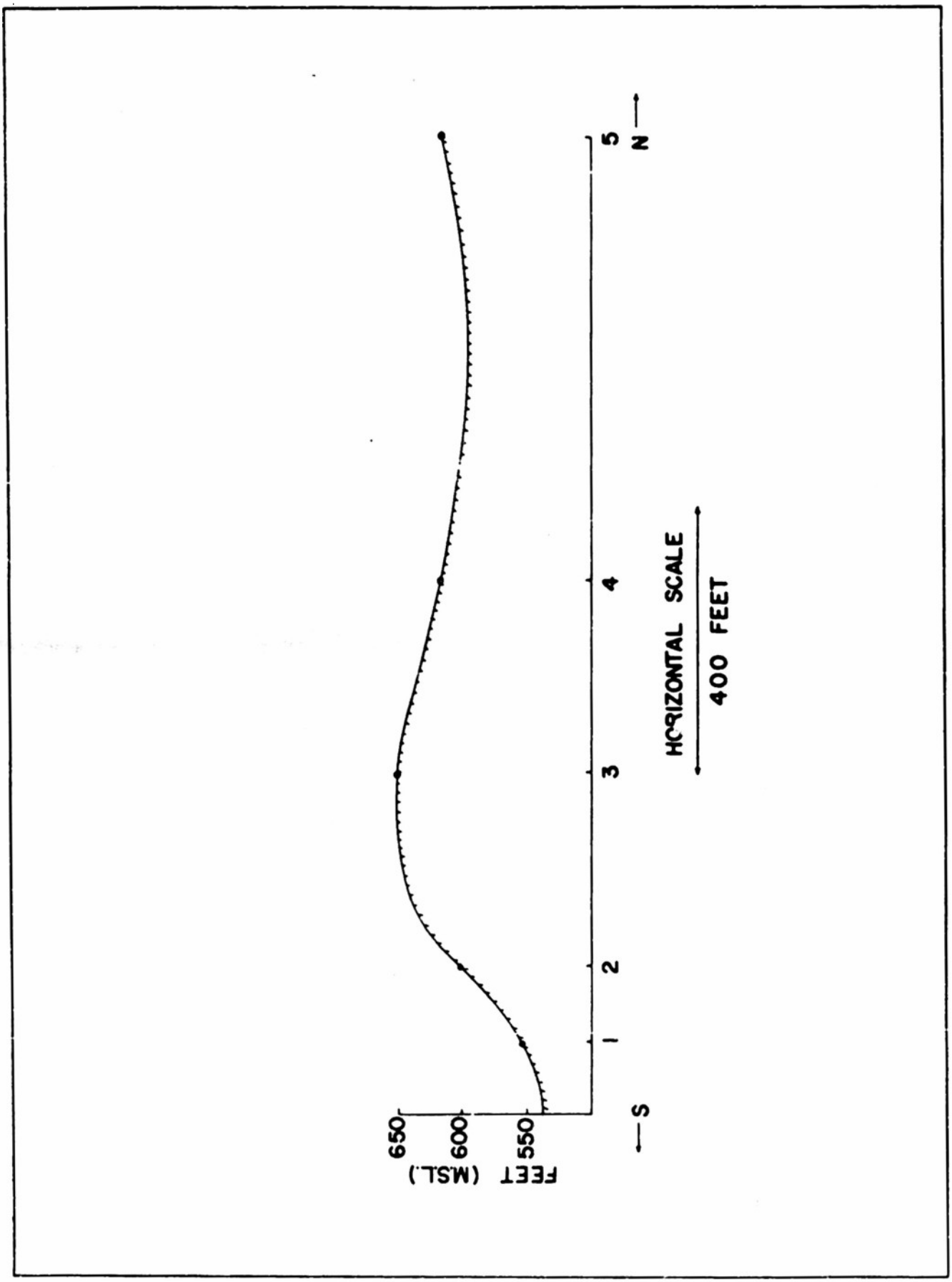

Figure 5. Schematic Cross Section Showing Slope and Distance between Sites 1-5

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Table I - Data Collected at Umiat Base Station

Data	Instruments
1) Total solar and sky radiation on a horizontal surface	10-junction Eppley Bulb, serial #2380, 42 ohms resistance, 2.22 mv. gm cal min^{-1} cm^{-2}.
2) Temperature at -22 inches (Correction of -0.7°F to be applied pt. #1)	Items 1-12 recorded once every 6 seconds on a 12-thermocouple point Brown Electronik Recorder. Model #153 X 60V12-X-32-F1; scale 0-5 mv; Chart #5451-N (3 inches/hr used), 115-volt, 60-cycle. Copper-constantan thermocouples used for temperature measurement; #30 gauge, bare, unshielded above ground; #24 gauge covered with a small bead of Sauereisen Insalute cement for for below-surface temperatures. Reference temperature for items 2-9 approximately 140°F maintained in a specially constructed insulated constant temperature block. (See Figure 8).
3) Temperature at -12 inches (-0.7°F, pt. #3)	
4) Temperature at -4 inches (-0.7°F, pt. #5)	
5) Temperature at -2 inches (-0.7°F, pt. #4)	
6) Temperature at -1/4 inches (-0.7°F, pt. #2)	
7) Temperature at 0 (unshielded) (-0.2°F, pt. #7)	
8) Temperature at +2 (unshielded) (-0.2°F, pt. #6)	
9) Temperature at +24 inches (unshielded) (-0.2°F, pt. #8)	

(Thermocouple points 9, 10, and 11 were reserved for leaf temperature or additional soil temperatures, but not used.)

10) Daily precipitation	Determined by weight, using a modified Victor Rain gauge as a collector. Orifice 2.88 cm diameter, collector tube 15 cm long.
11) Daily check psychrometer observation	H. J. Green Bureau of Mines type sling psychrometer, 1°F div.

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Table I Continued

12) Daily condensation on a copper plate in direct contact with the soil	Determined by the increase of weight of a 5 x 3-inch paper blotter used to absorb the condensation from a copper plate. (Capable of detecting .0002 inches of condensation)

Items 1-12 are available, except for a few breaks, from June 23-Aug. 30, 1952

13) Continuous air temperature at 6 feet above grass-covered soil inside a cotton region thermometer shelter (standard exposure for air temperature measurement)	Foxboro 3-pen, 7-day recorder with electric operation pen for 6-volt dc; 1 pen to give temperature at rear of recorder, other two pens connected to capillary stainless steel bulbs at end of 20 feet of compensated tubing. Spring driven clock. Scale 0 to +120°F.
14) Continuous black-bulb temperature at +3 inches	
15) Continuous soil temperature at -4 inches	
16) Continuous wind movement at 60 inches over raised polygon or 5 inches above highest alder	Bendix Aviation Corp. Model #349 cup anemometer modified to give 1 electrical contact for the passage of every 5 miles of wind.

Elements 13-16 are available June 25-Nov. 1, 1952 (except temperatures missing Sept. 27-Oct. 4)

17) Stereo Ektachrome and stereo black and white photos of the alder site nearly daily June 23-July 2 and at less frequent intervals after full leaf.	4 x 5-inch Speed Graphic Camera.
18) Several dust counts between June 22-27, 1952	Owens dust counter on loan from the US Weather Bureau.

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Table II - Data Collected at Sites 1-5

1) Continuous black-bulb temperature at top of vegetation.	Foxboro 2-pen 7-day temperature recorder with electric operation pen for use on 6-volt dc.
2) Continuous soil temperature at root level-usually 5 inches - but nearer surface at Sites 3, 4, & 5.	Two compensated capillary tubes 6 feet long having stainless steel bulbs; 7-day spring-driven clock, temperature scale 0 to +120°F.
3) Continuous wind movement at about 10 inches above vegetation tops.	One contact on 6-volt pen trace for every 5 miles of wind passage. Connected to modified model #349 Bendix Cup Anemometer.
4) Weekly accumulation of precipitation (These accumulated values were subject to evaporation, however, since the gauges were exposed beneath the alders at Sites 1 and 2. A rough estimate of the precipitation that reached the ground of these sites may be obtained).	Victor rain gauge. Orifice diameter 2.88 cm.
5) 8 copper constantan thermocouples were placed at each site, ranging from about -22 inches to the top of the vegetation with the plan that they be read at least weekly from a portable potentiometer. Unfortunately thermoelectric effects between the ends of the thermocouple leads and the switching device caused erroneous readings and the program was dropped for lack of time to remodel the equipment.	Foxboro Portable potentiometer model 8105, Serial J70212 upper curve S232. Range: -50 to +250°F.

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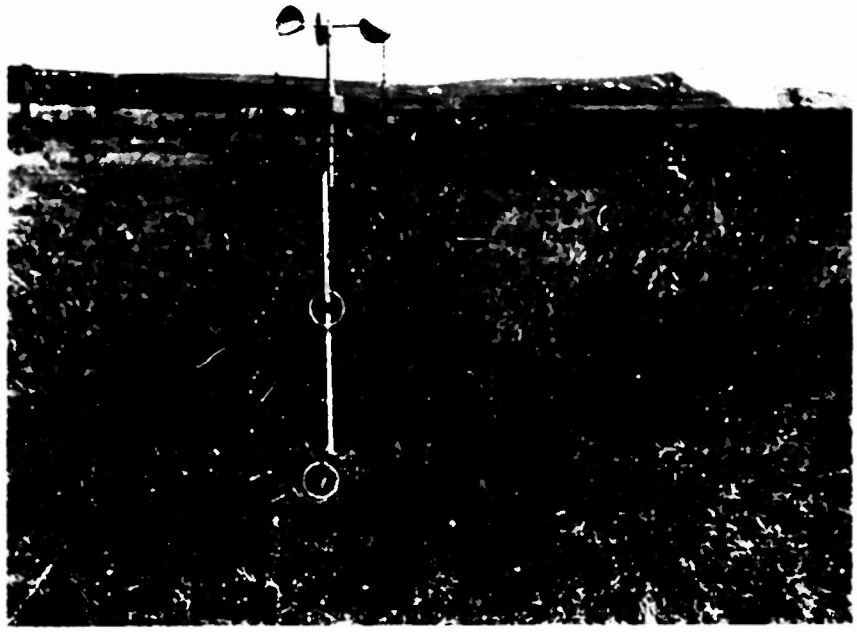


6a - Umiat Base, toward NE,

Air thermocouples encircled; soil thermocouples exposed directly below air thermocouples.

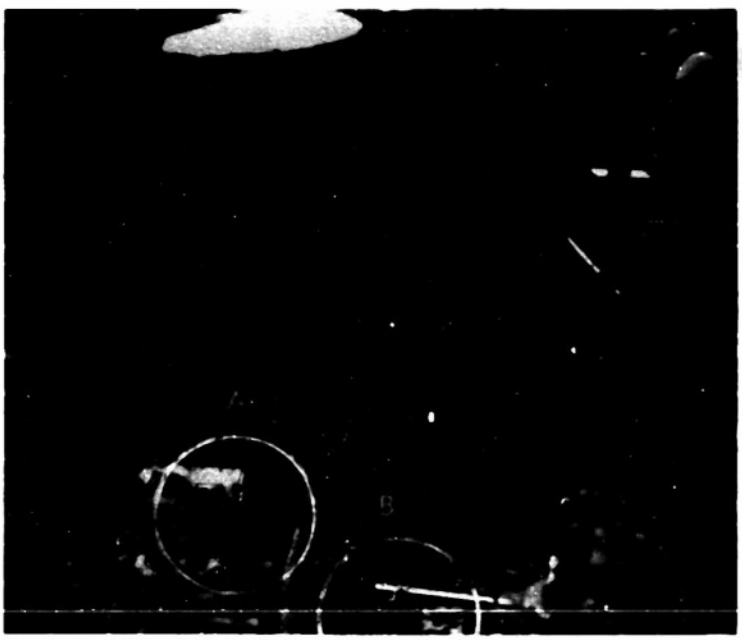
6b - Site 1, toward W.

8 to 10-foot alders and 10 to 12-foot willows. Anemometer at 9 feet (encircled); rain gauge 19 inches above ground; black-bulb thermometer at 8 feet, N-S and parallel with slope.

Figure 6. Views of the Umiat Base and Sites 1-5

6c - Site 2, toward NW

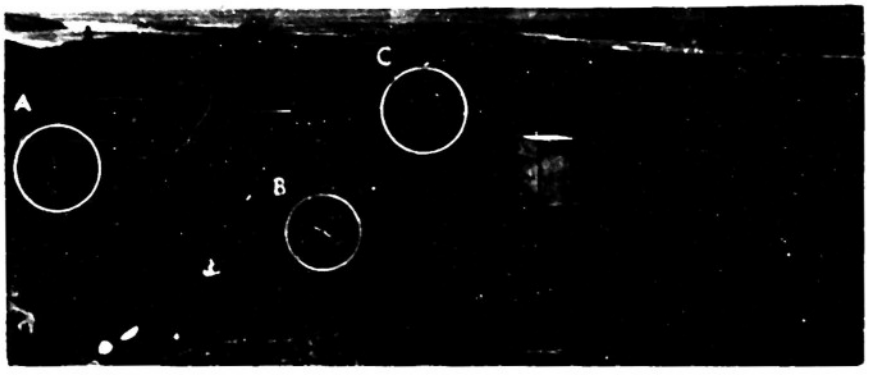
Alders and willows, not as tall as at Site 1; anemometer encircled.



6d - Site 2, toward SSW;

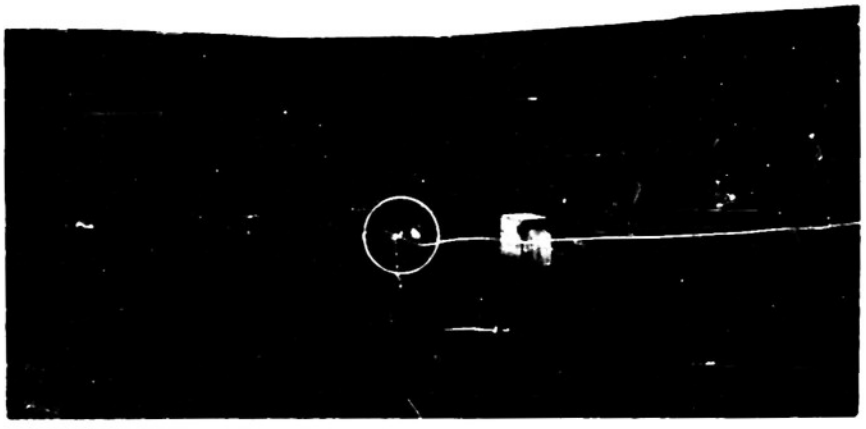
A and B are the rain gauge and black-bulb thermometer, respectively.

Figure 6. Views of the Umiat Base and Sites 1-5



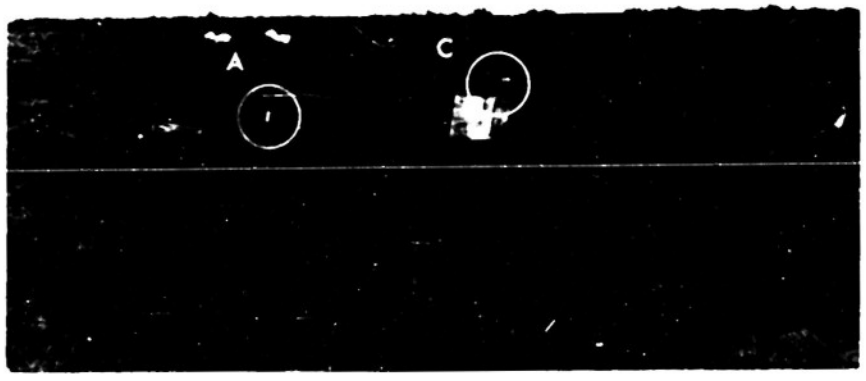
6e - Site 3, toward SE

Windswept ridge. Note taller brush to right-apparently protected by snowdrift. A, B, and C are rain gauge, black-bulb thermometer, and anemometer, respectively.



6f - Site 4, toward NW

Scattered low alders; anemometer encircled.



6g - Site 5, toward NW

A and C are rain gauge and anemometer, respectively.

Figure 6. Views of the Umiat Base and Sites 1-5

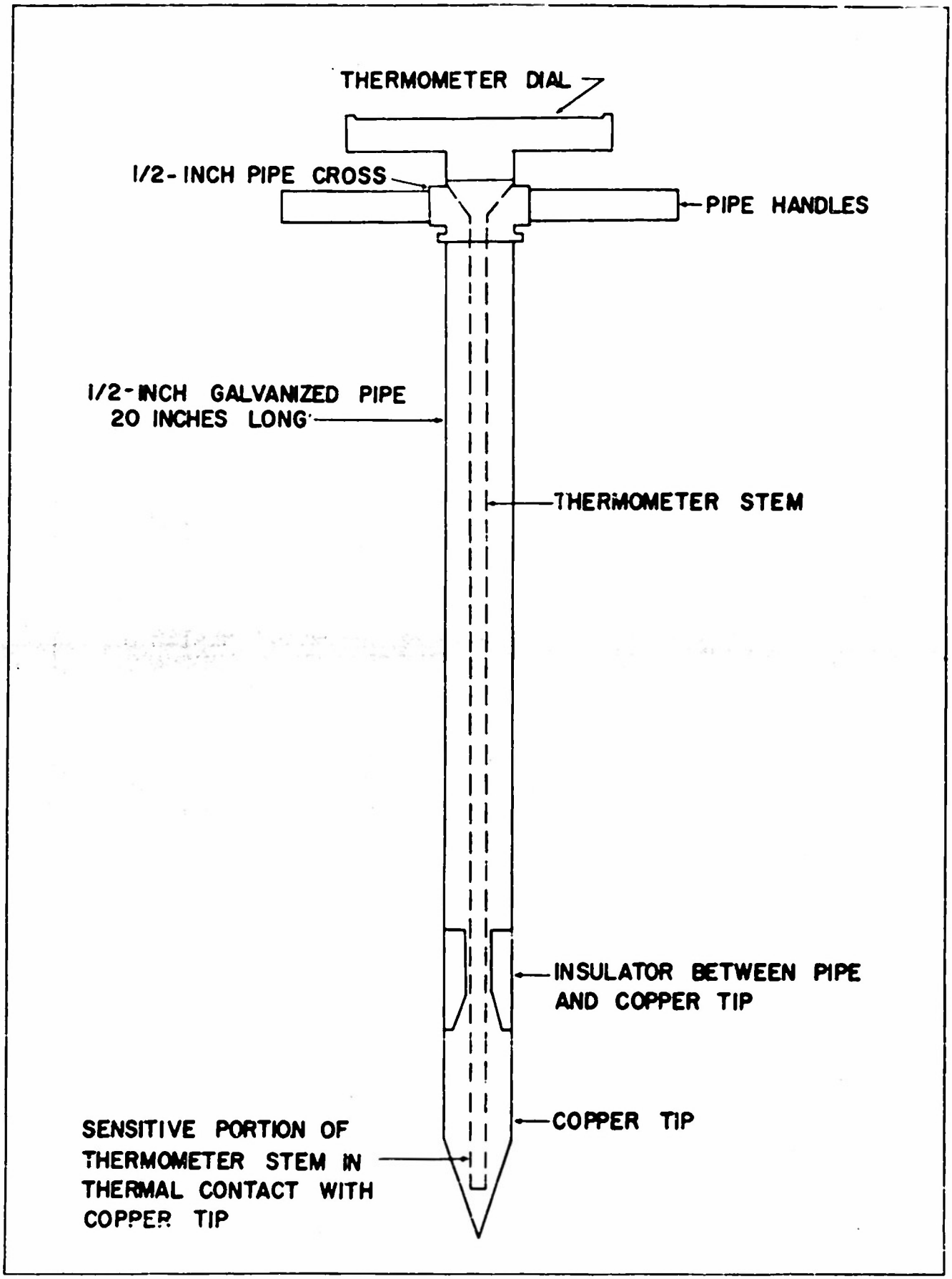


Figure 7. Schematic of Portable Temperature Probe

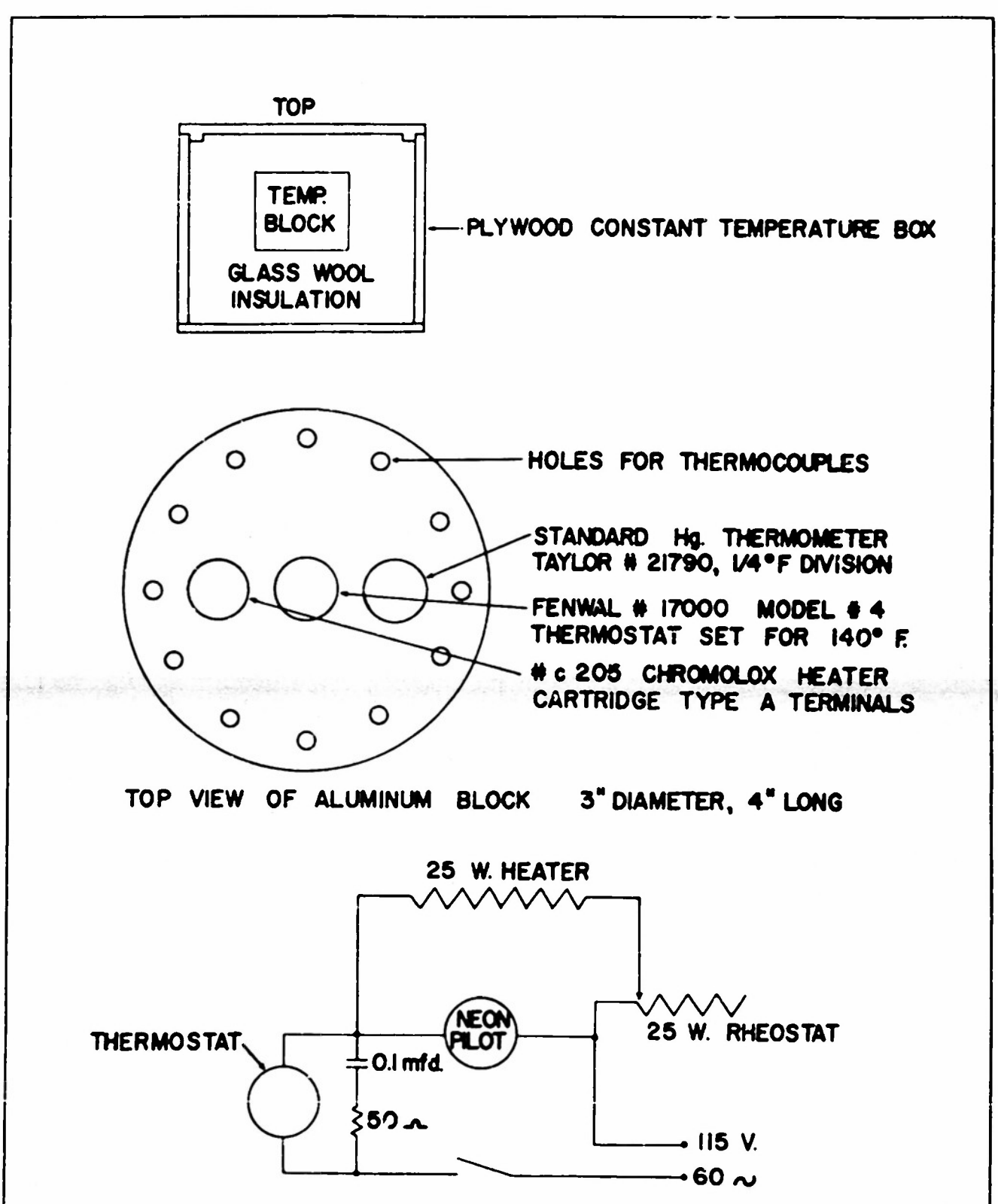


Figure 8. Schematic of Constant-Temperature Reference Box, Aluminum Block, and Wiring Diagram

V. MICROCLIMATE OF THE AREA

When the climate of an area is to be deduced without direct measurement but indirectly from vegetation form, etc., it is necessary to know what elements and to what degree each element may affect the vegetation. It should also be remembered that climate is only one of the factors affecting growth. It is entirely possible that at two separate plots under identical climatic conditions different types of vegetation will be found simply due to different chemical composition of the soil and perhaps due to stronger competition from other plants.

In the recent literature concerning plant growth much has been written concerning Thornthwaites[2] classification of climate. He reasons that desert vegetation is sparse and uses little water because water is deficient. If more water were available the vegetation would be less sparse and would use more water. Thus the need for water, as compared with water available, is a factor in the growth of vegetation. Thornthwaite devised a means of determining water need, which he calls potential evapotranspiration (PE). He states that, "the rate of evaporation depends on four things: climate, soil-moisture supply, plant cover and land management. Of these, the first two prove to be by far most important."

PE may be determined by observing the amount of water evaporated and transpired from a plot, covered with vegetation (the form of vegetation is quite insignificant as stated above) while an unlimited water supply is provided at a level below the surface. PE, which is expressed in depth of water, may also be calculated with reasonable accuracy from the mean monthly shelter temperatures and length of day. By superimposing the annual PE curve over the annual precipitation curve the time and amount of water surplus and need are illustrated. This

has been done for Barrow and Umiat and is shown in Figure 9. These curves show a water deficiency at Barrow of about 3.9 inches and 6.6 inches at Umiat, under the assumption that all the recharge precipitation was utilized. Continuing with Thornwaite's classification we find that from the moisture index the climate would be classed as semiarid for Umiat and Barrow and from the PE as microthermal for Umiat and tundra for Barrow. Sanderson[3] has set up evapotranspiration tanks at Ft. Norman (Northwest Territories, Canada) and found the measured amount in close agreement with the calculated. Sanderson also concludes that the Canadian Northwest suffers from drought.

From the above concepts it might be suspected that between regions where vegetation is different either PE or the available water is different. Since length of day is the same at the sites in question then only temperature difference could affect the PE values. Over this area precipitation is probably the same although that reaching the soil at Sites 1 and 2 under alder leaves may be different from Sites 3, 4, and 5 under dense ground covers. Another factor affecting available water which Thornthwaite did not have to consider in developing his empirical formula for temperate and tropical latitudes is the effect of permafrost. In late June, when a melting snowbank lay just above Site 2, it was observed at both Sites 1 and 2 that beneath the dry leaves a layer of ooze existed. The leaves and ooze were accidently stripped off by skidding which exposed frozen soil. Then, within a few seconds a rivulet of water could be seen flowing over the frozen soil. In this way sites like 1 and 2, on steep slopes, may be supplied with moisture in excess of that derived from the precipitation alone. How much of this water may be attributed to melting snow is not known but some of the water must have come

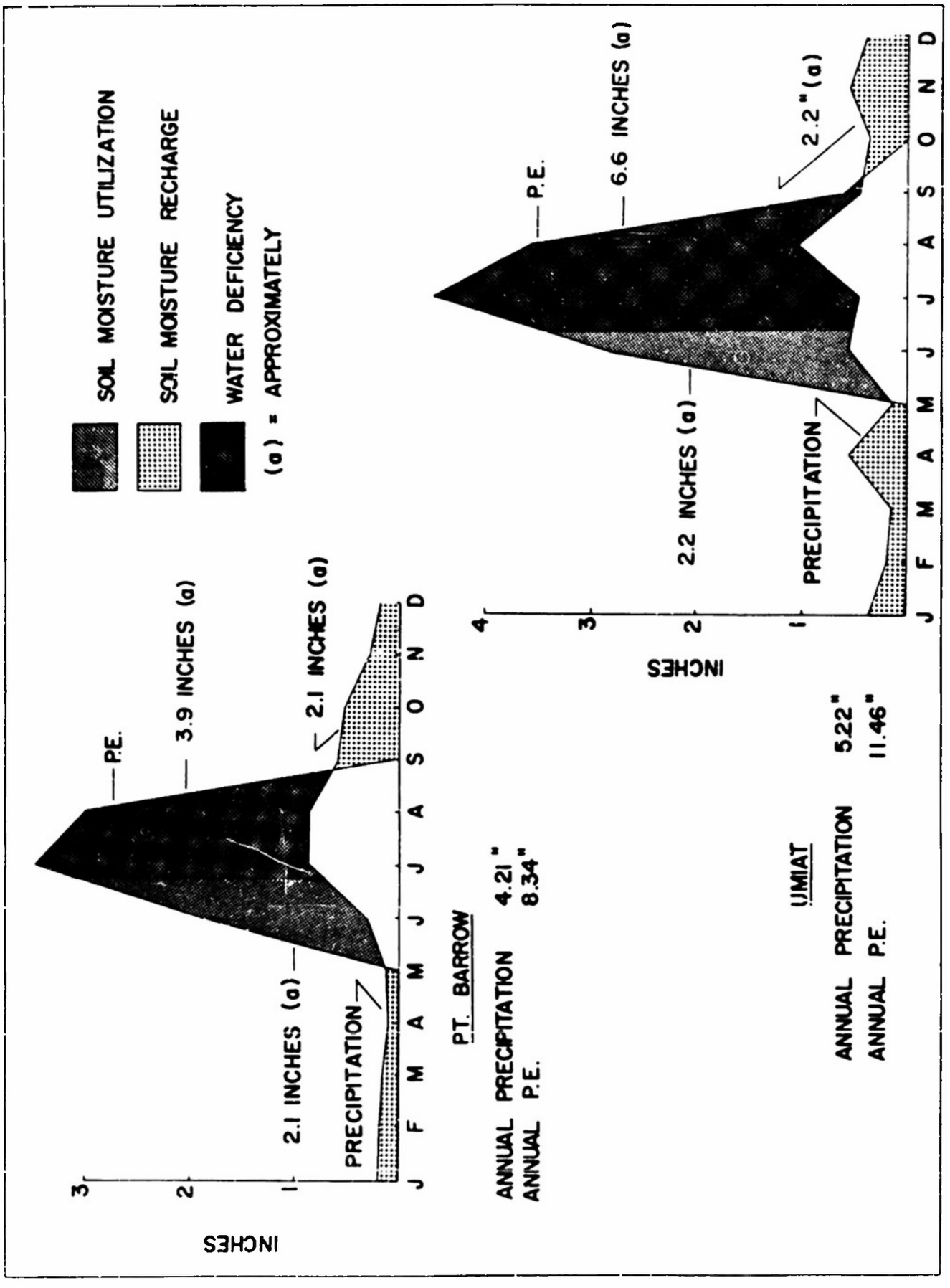


Figure 9. Measured Precipitation and Computed Potential Evapotranspiration for Point Barrow and Umiat

from thawing ground upslope. Similarly, sites on a ridge, like 3, loose their ground water reserve quickly and suffer from further water deficiencies.

Benninghoff[4] has pointed out that where drainage is poor the release of frost causes waterlogging. Presumably this effect is greatest in the early summer before PE becomes high.

Raup[5] and Sigafoos[6] have emphasized that cryoplanation, or the effect of soil movement, is probably the most important factor affecting Arctic vegetation. Sigafoos states that vegetation is not climax because of continual soil movement, in fact, soil movements are frequent in respect to the life of the plant. Therefore, the plants have not had time to react to the climate. He says that the most stable sites at high latitude are on the stream banks and that vegetation must be described and understood in terms of the unstable substrata; and that climax concepts should not be used. Benninghoff[4], in his discussion of the thawing and freezing of the ground which tears root systems, adds that the effect is most pronounced in the autumn. In the springtime a snow cover diminishes this action. He also points out the effect of cold fall winds on new exposed growth. This effect appears at Site 3. Early fall drifting snows fill in the hollows while the frost boils are barely covered. The growth of the previous season extends from one to two inches above this level leaving it exposed to the first cold wind. Careful observation showed that the height of the live wood corresponded to a gently sloping surface which would conform with the upper surface of drifting snow.

From the above it appears that Thornthwaite's empirical formula should break down over an area having a rather shallow active layer of soil under which a deep layer of permafrost exists.

VI. ANALYSIS OF THE DATA

Since surface soil temperature measurements ended August 30 and only one 4-inch level was run to November 1, a study of the frequency of thawing and freezing at the surface cannot be made. Nevertheless, other evaluations of the records have begun and a few interesting graphs have been prepared.

Bensin[7] has set 41°F (5°C) as a critical temperature below which growth is practically zero. From this very tentative value, graphs showing the relative durations of soil temperatures above 40°F at -4 inches have been prepared. The durations are shown in Figure 10 in the form of accumulated hours vs time for the Umiat Base and Sites 1 through 5. It is interesting to note that Umiat Base, having the wettest soil, is the last to warm up to 41° and accumulates the lowest number of hours for the season. Site 2, which was under about 12 inches of snow on June 26, rose above 41° only one day after Site 1, which was under dry leave litter at the surface on June 26. The ridge-top station, Site 3, had to be estimated prior to June 29 but it obviously accumulated more hours than the others. These curves appear to be directly related to drainage and soil moisture content more than aspect.

Lehenbauer[8] and others have shown that there is always an optimum temperature for growth. This temperature varies somewhat with the material and the length of exposure but it is always near 86°F. Lehenbauer's curve of growth rate, expressed as per cent of optimum vs temperature, is shown in Figure 11. From this data curves showing relative growth at Umiat Base and Site 2 have been prepared. Mean hourly black-bulb temperatures at the top of the vegetation

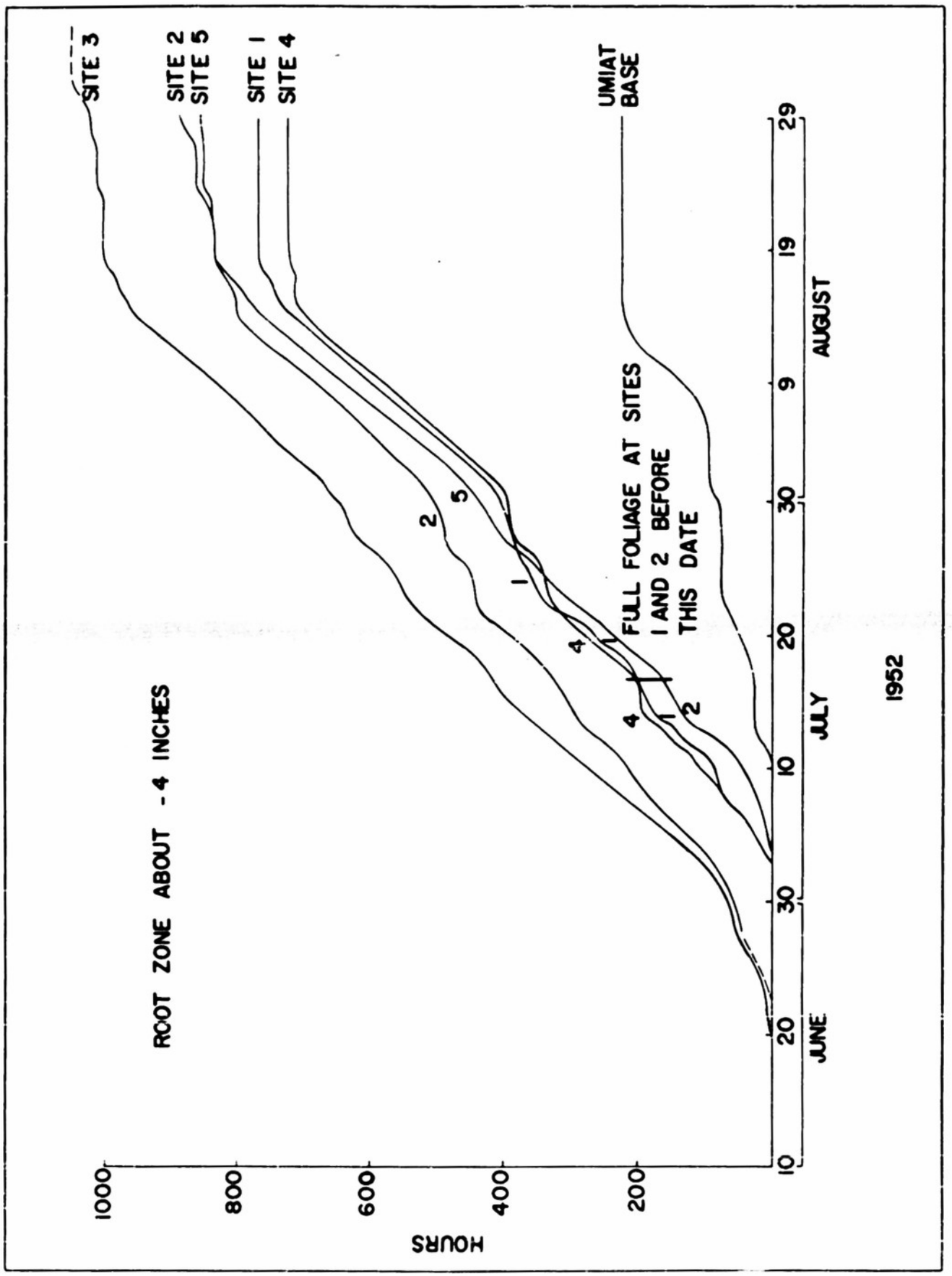
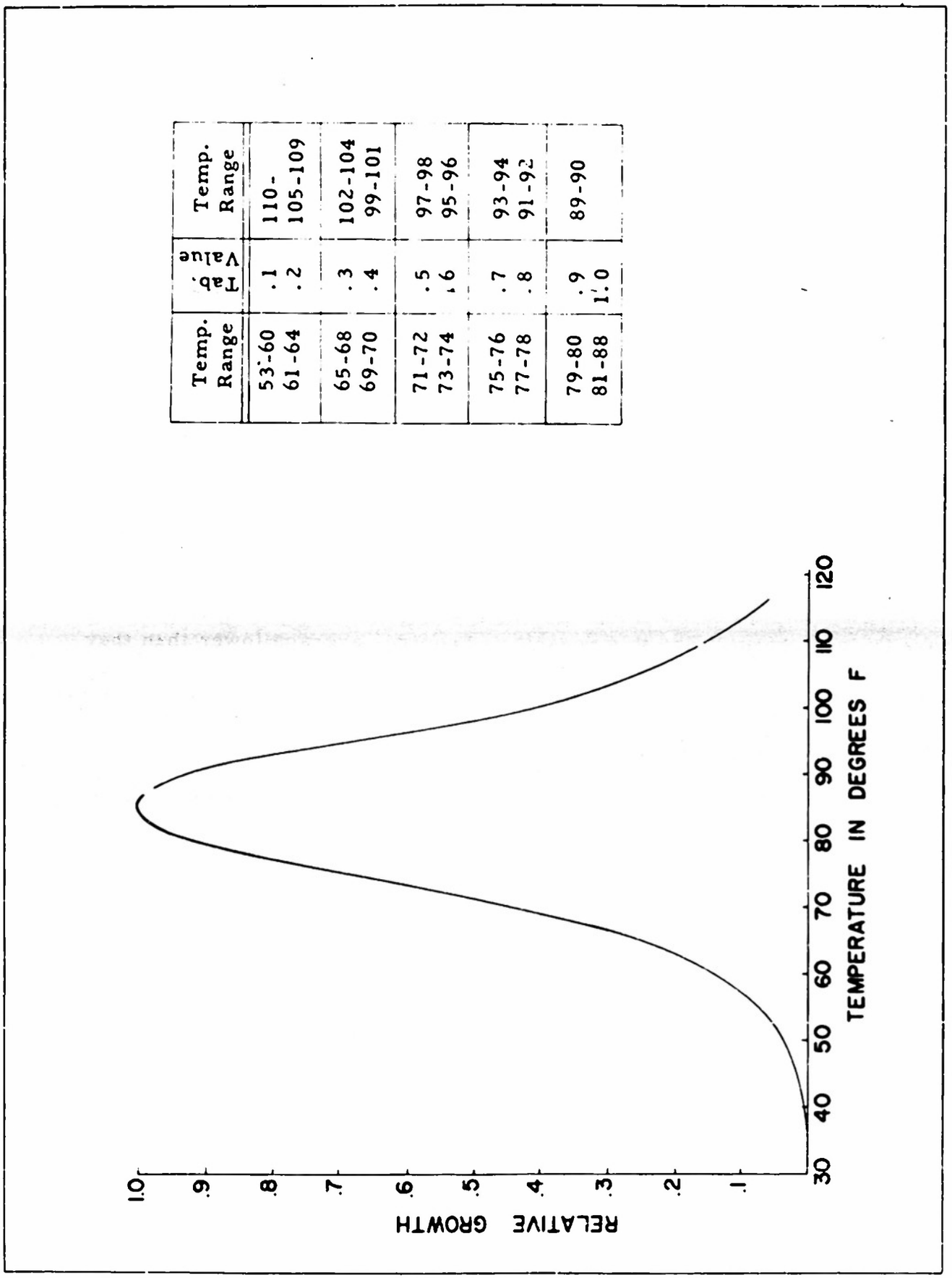


Figure 10. Accumulated Hours with the Root Zone above 40 Deg F.



Temp. Range	Tab. Value	Temp. Range
53-60	.1	110-
61-64	.2	105-109
65-68	.3	102-104
69-70	.4	99-101
71-72	.5	97-98
73-74	.6	95-96
75-76	.7	93-94
77-78	.8	91-92
79-80	.9	89-90
81-88	1.0	

Figure 11. Lehenbauer's Growth Rate Curve

were tabulated* and used since it was felt that these values were nearer to the leaf temperature than the air temperature. Actually leaf temperatures average less than the black-bulb values during daylight hours due to transpiration. After each mean hourly temperature had been determined it was given a weight of 0 to 10; 0 corresponding to no growth, and 10 to maximum growth as read from the table of relative rates. The 24 hours for each day were added and the daily values then added to give growth accumulations vs time. These growth rate accumulations are shown in Figure 12.

According to this method of determining relative growth, Umiat Base, Site 3 and Site 5 experience almost identical conditions. The Site 2 curve is probably too low since it was partially shaded after the foliage came out. At Site 1 the thermometer had to be exposed 8 feet perpendicularly from the ground in order to be above the vegetation. For this reason its readings average lower than they would have near the ground without shading vegetation. The effects of a northern slope are shown by the lower accumulation at Site 4.

An attempt has been made to measure the actual growth of the birch shrub at Umiat Base. for which daily photos are available over the first part of the summer and less frequently thereafter. This was done from the 4 x 5-inch color films using a precision measuring device capable of measuring differences to 0.001 mm (25-power magnification was used). The growth of woody stem at the tip of a branch was measured but the results are poor; it was almost impossible to determine the exact lengths to measure because the distinction between bud

*See Appendix, Tables A-2 to A-8, for hourly black-bulb temperatures, daily, weekly and seasonal averages for all the stations.

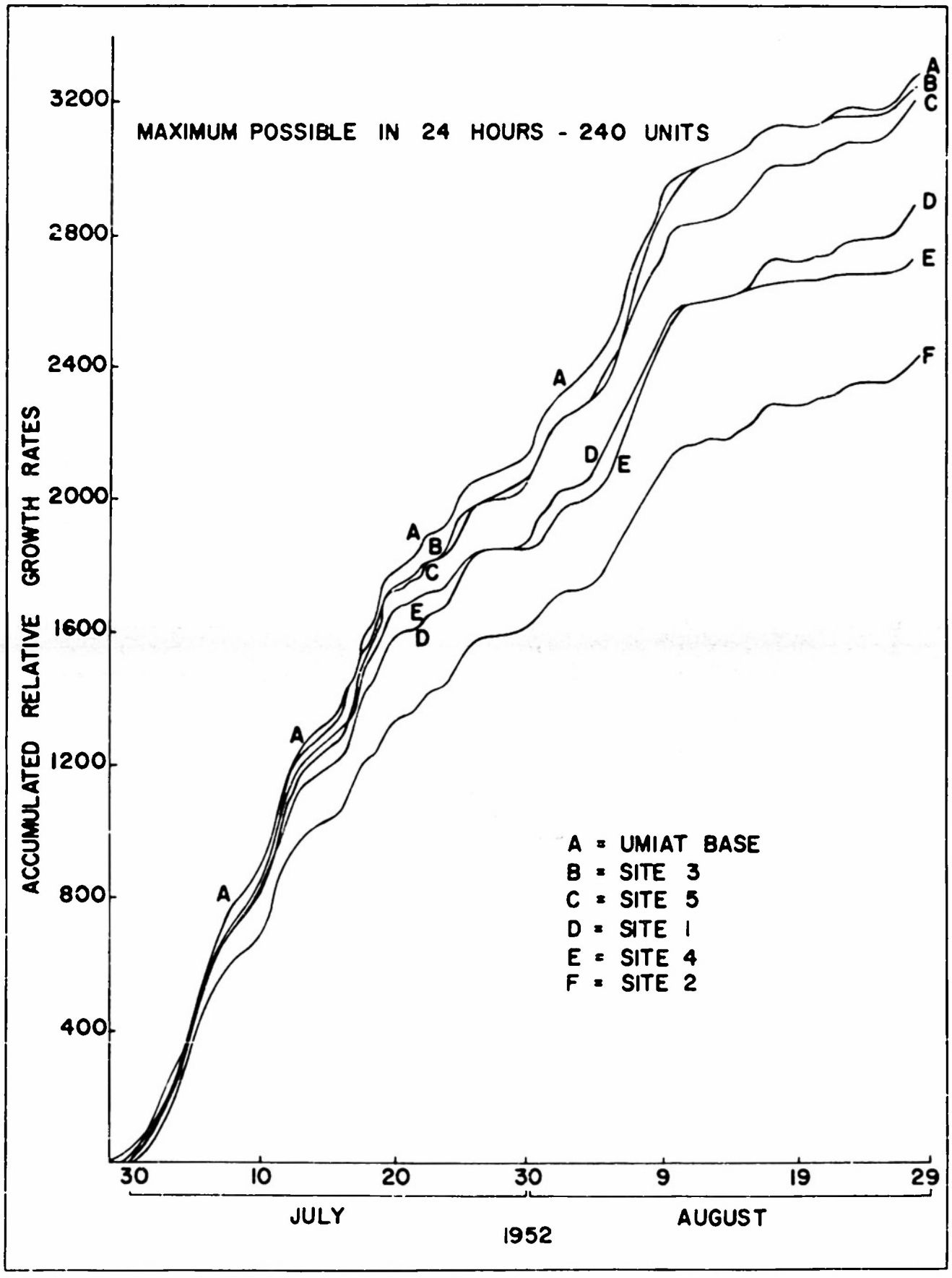


Figure 12. Growth Rate Accumulation as Determined from the Black Bulb Thermometer

and stem could not always be made. The growth measurements obtained are shown in Figure 13 on a scale equal to the measured change on the film. True growths in centimeters are approximately 2.3 times the value given. Thus the total growth from June 23 to its completion, apparently around July 18, is about 3.0 cm; since the highest part of the shrub was about 140 cm, the approximate age would be 47 years. This figure is reasonable, as compared with a ring count of over 20 years on a similar, nearby shrub. In Figure 13 curves of calculated growth, black-bulb temperature at +4 inches, shelter temperature (+6 feet) and total radiation on a horizontal surface, all adjusted to the time period from photo to photo, are also shown for most of the period when growth measurements could be attempted. It is clear that the most rapid growth appears to follow the time of expected increase by one photo, or in this case, two days. A re-examination of the photos show that the July 4 photo could be interpreted differently and made to show a large increase. This is, of course, a weakness of the method. Nevertheless, a glance at three of the photographs, reproduced in black and white as Figure 14, shows a very rapid greening up and opening of the leaves with the increased warmth of July 3. It is also very obvious that the leaves open first near the ground. The lag of the upper leaves over the lower ones may be compared with the vertical temperature distribution through the shrub, but analysis of this temperature data has not yet been completed. From such data the amount of heat required for the leaves to reach certain stages of development may be determined.

The effects of wind prevailing from a single direction at Umiat Base and Sites 4 and 5 were observed. At each of these stations the brush, consisting of alder or birch leaned toward the southwest. This is of interest, because from

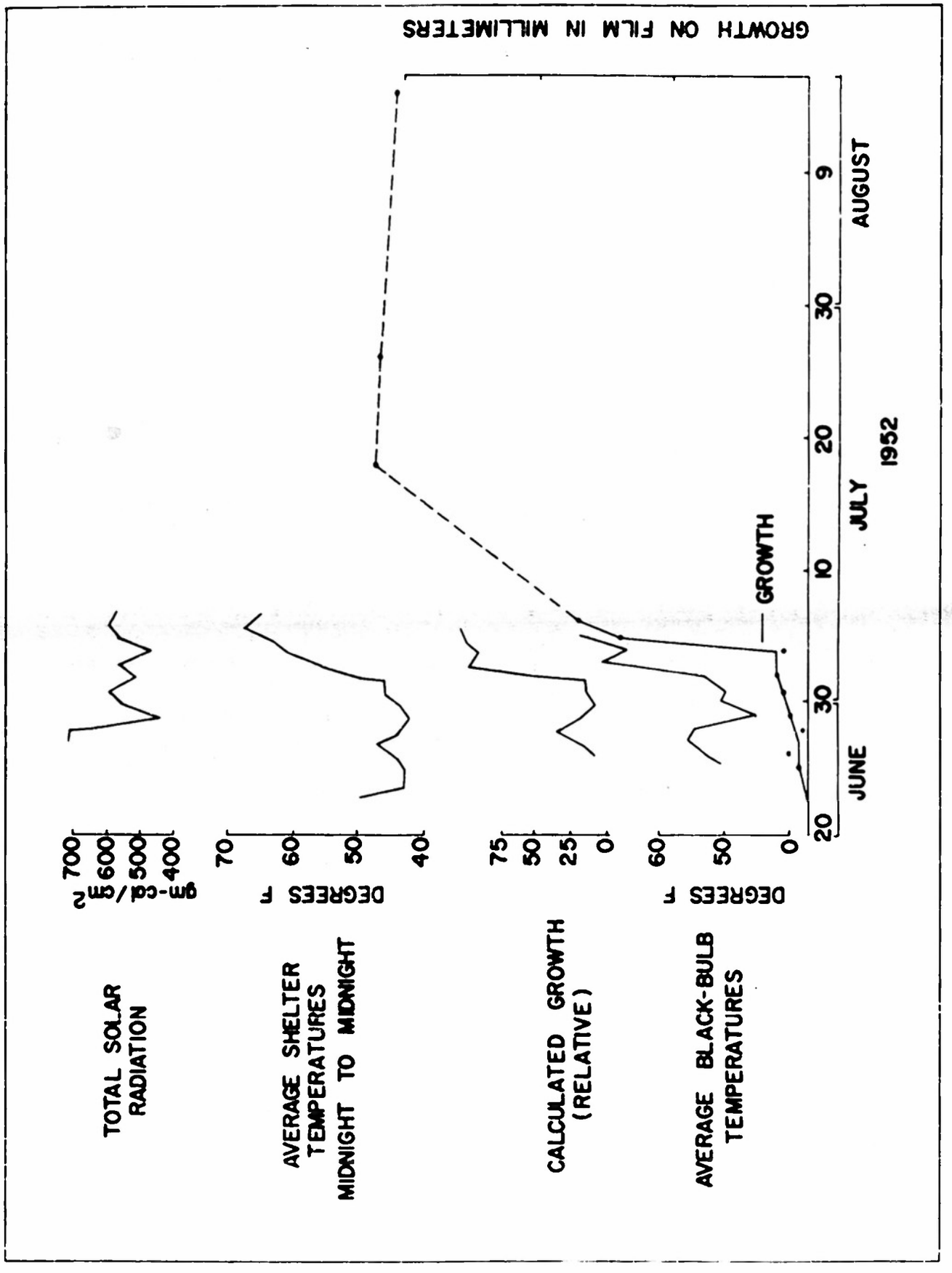


Figure 13. Measured Growth at the Tip of a Birch Shrub at Umiat Base vs Calculated Growth, and Other Heat Measurements

the Umiat Climatological summary the monthly prevailing winds are given as east throughout the growing season and west the remainder of the time. The different observed wind directions of 5 mph or more, measured about 25 feet above the ground, have been broken down into weekly periods for the season of 1952 in Figure 15. Winds below 5 mph were arbitrarily omitted because it was thought that they were too weak to appreciably affect the shrub. If this particular season is representative of the normal, it may be seen that easterly winds are very frequent at the beginning and ending of the season while the westerlies are about as frequent in the middle of the season.

It is not certain at this point but it appears evident that prevailing winds of significant strength over the growing season may be deduced from the lean of shrubs.

The few dust measurements made at Umiat Base during an east wind in late June showed no particles after 100 strokes with the Owens dust counter.

VII. CONCLUSIONS AND RECOMMENDATIONS

Conclusions at this stage of study are hazardous, therefore they must be considered tentative. However, from the work already done, some of the microclimatic values at the different sites may be summarized. They are shown in Table III.

From this preliminary inspection of the data and review of the literature the impression is formed that:

1) Only a few microclimatic elements, such as prevailing wind direction during the growing season and average depth of snow cover in the fall at specific exposures, may be determined directly from aerial photo-

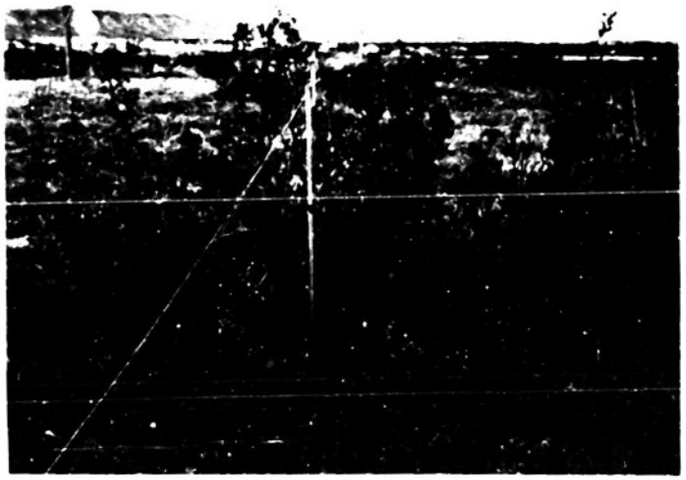


Figure 14 Photographs Showing the Change in Vegetation over the Period June 28 to July 4

Table III - Microclimatic Values Deduced from Data

	Umiat USWB	Umiat Base	Site 1	Site 2	Site 3	Site 4	Site 5
Average wind speed June 30 - Aug. 27 (mph)	6.8 (25-ft. tower)	4.4	1.4	1.0	4.9	2.8	3.0
Precipitation July 3 - Aug. 26	1.95	1.99	0.56*	1.51*	2.17*	3.32*	2.34*
Hrs $\geq$ 41° at -4 inches (June 30 - Aug. 28)		227	770	885	970	793	809
Rel. growth June 30-Aug. 28		3285	2826	2425	3242	2723	3209
Last date $\leq$ 32° First date $\leq$ 32° (Black-bulb)		June 20a July 18	July 1 Aug 16	July 1 Aug 16	July 1 Aug 16	July 1 July 25	July 1 July 26
Consecutive days >32°(Black-bulb)		28	46	46	46	24	25
Remarks		Cold wet soil; wind whip	High growth; no no wind whip	High growth; no wind whip	Dry, warm soil but growth killed by cold fall winds	Slight wind whip	Slight wind whip

* Unreliable-weekly totals vs Umiat and Umiat Base do not compare well.
a = approximate

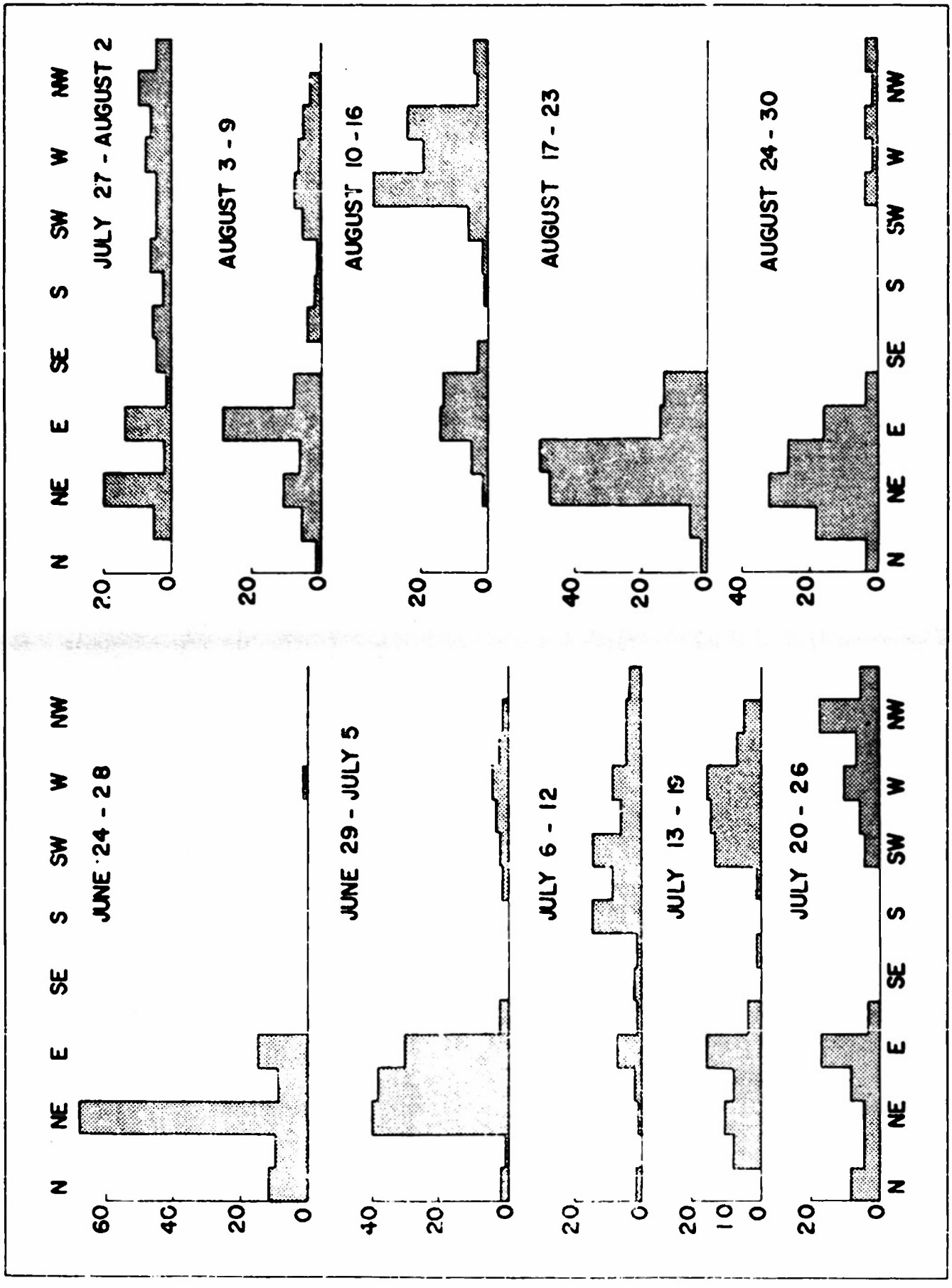


Figure 15. Frequency of Winds of 5 MPH or More by Directions at Uniat US Weather Bureau Station, 1952

graphs.

2) Vegetation forms in most areas are influenced by frost action and soil moisture content. These factors, even if known, probably could not be related to the usual climatic elements of temperature, precipitation, cloudiness, etc.

3) Just how much progress can be made from general climatic estimates toward microclimatic estimates based on aerial photographs alone cannot be answered now, and for this reason all of the data collected in 1952 should be tabulated and evaluated in respect to plant growth as far and as soon as possible.

Weaknesses have been revealed in last summers program and in order to proceed toward a satisfactory answer of (3) above the following recommendations are made:

1) equipment should be set up before the snow cover disappears and the ground is still all frozen, and also before the black-bulb temperature rises above 53°F;

2) daily growth measurements should be made;

3) soil moisture should be measured and an attempt made to determine availabie water to check PE theory;

4) cryoplanation vs microclimate should be studied (this may require additional soil surface temperatures);

5) the precipitation and condensation should be measured more accurately;

6) the further use of growth calculations should be investigated;

7) more humidity measurements should be made in the vegetation and the vapor pressure deficit vs growth should be studied.

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APPENDICES

Table A-1

LOCAL CLIMATOLOGICAL DATA WITH COMPARATIVE DATA UMIAT, ALASKA, 1952

Source: U.S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

LATITUDE 69° 22' N
LONGITUDE 152° 08' W
ELEVATION (ground) 337 feet

METEOROLOGICAL DATA FOR THE CURRENT YEAR

UMIAT, ALASKA
UMIAT AIRPORT
1952

Month	Temperature: Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days	Precipitation: Total	Greatest in 24 hrs	Date	Snow, Sleet, Hail: Total	Greatest in 24 hrs	Date	Relative humidity: 2:30 a. AST	8:30 a. AST	2:30 p. AST	8:30 p. AST	Wind: Average hourly speed	Prevailing direction	Fastest mile: Speed	Direction	Date	Percent of possible sunshine	Average sky cover sunrise to sunset	Number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation 01 inch or more	Snow, Sleet, Hail 1.0 or more	Thunderstorms	Heavy fog	Max. temp: 70° and above	32° and below	Min. temp: 32° and below	Zero and below
JAN.	-19.1	-33.7	-26.4	22	16	-51	20	2841	0.37	0.24	16	3.7	2.4	16	-	-	-	-	9.8	#					3.1	11	1	5	7	1	0	0	0	31	31	29
FEB.	-29.8	-43.1	-36.5	-12	11	-57	21	2949	0.03	0.02	11	0.4	0.3	11	-	-	-	-	6.3	#					3.7	15	7	7	2	0	0	0	0	29	29	29
MAR.	-14.0	-33.0	-23.5	11	10	-47	21	2750	0.22	0.11	16	2.2	1.1	16	-	-	-	-	6.3	#					5.6	12	7	12	6	1	0	0	0	31	31	31
APR.	4.8	-16.6	-5.9	34	8	-46	15	2131	0.17	0.07	19	1.8	0.8	25-26	76	69	70	76	6.1	#					6.6	5	9	16	6	0	0	0	0	29	30	23
MAY	23.9	7.5	15.7	35	26+	-22	3	1522	0.14	0.07	23-24	1.4	0.7	23-24	86	81	76	82	7.1	E					7.5	5	4	22	6	0	0	2	0	27	31	9
JUN.	45.7	32.7	39.2	60	23	26	1	765	0.32	0.19	21-22	T	T	18+	92	85	78	86	9.8	E					8.3	1	7	22	4	0	0	3	0	3	12	0
JUL.	64.7	44.6	54.7	81	6	33	2	316	1.29	0.33	28	0.0	0.0		92	75	56	70	5.9	E					7.7	2	12	17	10	0	1	1	11	0	0	0
AUG.	55.6	37.6	46.6	75	8+	24	27	562	0.66	0.23	13-14	T	T	21	94	84	63	81	7.3	NE					7.7	3	7	21	9	0	1	4	4	0	13	0
SEP.	32.7	23.2	28.0	43	13+	12	29	1104	0.61	0.35	3	5.8	3.3	3	91	89	81	90	9.0	ESE					9.0	1	3	26	13	1	0	1	0	15	30	6
OCT.	24.0	6.7	15.4	45	5	-18	23	1530	0.42	0.14	19-20	7.9	3.6	19-20	80	78	78	80	6.3	WSW					8.2	3	6	22	12	3	2	2	0	24	31	13
NOV.	12.1	6.6	3.3	43	23	-28	15	1850	0.58	0.27	10-11	6.8	3.3	10 11	-	-	-	-	-	-					-	-	-	-	7	3	0	-	0	28	30	24
DEC.	-12.0	-24.6	-18.3	1	27	-45	12	2592	0.32	0.10	7	3.7	1.0	7+	-	-	-	-	-	-					-	-	-	-	6	2	0	-	0	31	31	31
Year	15.8	- 0.4	7.7	81	JUL. 6	-57	FEB. 21+	20912	5.13	0.35	SEP. 3	33.7	3.6	OCT. 19-20	-	-	-	-	-	-					-	-	-	-	88	11	2	-	15	248	299	189

(Part time CAA station November 15 1952.)

MEANS AND EXTREMES FOR PERIOD OF RECORD

Month	Temperature: Means: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Mean degree days	Precipitation: Mean total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs	Year	Snow, Sleet, Hail: Mean total	Maximum monthly	Year	Maximum in 24 hrs	Year	Relative humidity #: 2:30 a. AST	8:30 a. AST	2:30 p. AST	8:30 p. AST	Wind: Mean hourly speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct of poss sunshine	Average sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation 01 inch or more	Snow, Sleet, Hail 1.0 or more	Thunderstorms	Heavy fog	Max temp: 70° and above	32° and below	Min temp: 32° and below	Zero and below
(a)	5	5	5	5		5		5	5	5		5		5		5	5		5		3	3	3	3	3	3					4											
J	-11.8	-20.6	-21.2	30	1950	-62	1951	2676	0.31	0.88	1950	0.05	1948	0.24	1952	3.4	9.2	1950	2.4	1952	77	78	76	77	9.1	#					5.8											
F	-18.4	-35.7	-27.1	28	1948	-63	1951	2616	0.20	0.36	1951	0.03	1952	0.20	1948	2.0	4.0	1951	1.2	1951	72	70	72	73	7.8						4.7	11	7	10								
M	-8.3	-26.3	-17.3	35	1949	-50	1951	2557	0.18	0.22	1952	0.13	1950	0.11	1952	2.2	2.8	1948	1.1	1952	73	72	75	75	6.1						5.4	10	7	13								
A	9.5	-11.4	0.9	40	1951	-46	1952	1979	0.41	1.50	1948	0.10	1950	0.30	1948	4.1	14.5	1948	4.2	1948	79	76	77	80	7.8						6.4	3	7	16								
M	27.2	10.0	20.1	55	1951	-22	1952	1388	0.11	0.21	1949	T	1951	0.07	1952+	1.2	3.5	1949	1.5	1949	88	81	77	85	8.7						7.6	3	3	25								
J	49.8	34.4	42.1	73	1951	20	1949	683	0.53	0.94	1946	0.20	1950	0.36	1951	0.9	4.4	1948	2.1	1948	91	79	71	77	9.7						7.9	2	3	25								
J	63.8	43.2	53.5	85	1951	31	1949	352	0.84	1.68	1951	0.14	1950	0.62	1951	T	T	1949+	T	1949+	91	77	62	76	7.0						6.9	2	2	18								
A	57.8	39.0	48.4	77	1951+	24	1952+	509	1.20	2.26	1951	0.49	1949	0.80	1951	0.4	2.0	1948	0.7	1948	95	83	66	83	8.8						7.8	2	6	23								
S	38.5	26.1	32.3	63	1950	- 6	1948	977	0.57	0.86	1951	0.36	1949	0.41	1950	2.0	5.8	1952	3.3	1952	93	90	81	90	7.7						9.1	1	5	24								
O	21.1	5.8	13.5	45	1952	-19	1948	1594	0.41	0.56	1951+	0.14	1949	0.36	1951	5.6	7.9	1952	3.6	1952	84	83	83	85	5.2	WSW					7.9	1	4	26								
N	9.4	- 7.9	0.8	43	1952	-53	1948	1926	0.53	1.07	1950	0.28	1949	0.27	1952+	6.7	10.7	1950	3.3	1952	82	83	82	78	8.7						8.9	0	2	28								
D	-12.9	-28.6	-20.8	31	1951	-56	1948	2662	0.42	0.35	1951	0.08	1948	0.32	1951	4.7	6.5	1951	3.2	1951	78	76	76	78	7.6							2	2	27								
Year	18.8	1.8	10.3	85	JUL. 1951	-63	FEB. 1951	19921	5.71	2.26	AUG. 1951	T	MAY 1951	0.80	AUG. 1951	33.2	14.5	APR. 1948	4.2	APR. 1948	83	79	75	80	7.7	#					7.2	51	72	197	106	11	1	26	132	352	291	179

(a) Length of record, years. # 2 years - January, February, March, November and December. ∅ Sun below horizon continuously from November 30th through January 14th.

Table A-1

UMIAT, ALASKA
UMIAT AIRPORT
1952

AVERAGE TEMPERATURE

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1945	-	-	-	8.0	20.5	40.8	[illegible]	43.4	33.6	[illegible]	[illegible]	-21.0	-
1946	-23.8	-25.8	-15.8	7.5	28.6	49.2	[illegible]	46.8	28.4	19.7	[illegible]	-25.5	9.9
1947	-23.4	-26.8	-15.4	3.4	20.8	47.4	[illegible]	41.3	31.9	8.4	[illegible]	[illegible]	[illegible]
1948	-26.3	-12.6	-10.8	9.5	17.3	38.4	[illegible]	43.5	[illegible]	10.3	[illegible]	[illegible]	[illegible]
1949	-16.3	-27.9	-4.8	3.6	19.5	39.6	[illegible]	[illegible]	[illegible]	16.1	[illegible]	-19.9	[illegible]
1950	-2.0	-29.9	-12.8	[illegible]	25.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.9	[illegible]	[illegible]
1951	-37.7	-28.5	-16.8	[illegible]	26.5	[illegible]	[illegible]	49.5	24.3	10.6	[illegible]	[illegible]	[illegible]
1952	-26.4	-36.5	-21.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29.3	[illegible]	[illegible]	[illegible]	[illegible]

TOTAL PRECIPITATION

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1945	[illegible]	-	-	.16	.19	.82	.90	1.55	.33	.70	.54	.06	-
1946	[illegible]	.04	[illegible]	.10	*	1.26	.86	-	-	-	-	-	-
1947	*	.02	.24	.04	.02	*	.59	4.00	.17	.77	.16	.29	5.91
1948	.05	.05	.19	1.50	.07	.94	.98	1.71	.33	.28	.41	.08	7.00
1949	.09	.10	[illegible]	.12	.21	.63	.17	.49	.36	.14	.28	.44	3.19
1950	.18	.16	.13	[illegible]	.14	.20	.14	.88	.64	.56	1.07	.61	5.51
1951	.18	.16	.19	.14	*	.56	1.68	2.28	.86	.56	.30	.66	7.77
1952	[illegible]	.01	.22	[illegible]	.14	.32	1.29	.66	.61	.42	.58	.92	5.13

MONTHLY AND SEASONAL SNOWFALL

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1944-45	-	-	-	-	-	-	-	-	-	-	4.8	T	-
1945-46	0	2.1	0.1	6.5	5.8	0.4	1.0	0.4	1.9	0.4	T	0	18.6
1946-47	T	-	-	-	-	-	T	0.8	1.4	0.4	0.3	T	-
1947-48	0	0.1	T	7.7	5.8	5.1	1.5	3.8	2.8	14.5	0.1	4.4	42.2
1948-49	T	3.0	3.8	9.3	8.3	0.8	0.8	1.3	2.0	1.4	3.5	0.1	28.5
1949-50	T	T	0.2	3.5	8.9	8.4	9.2	1.7	1.4	1.2	0.9	T	31.4
1950-51	0	0	0.2	4.8	10.7	8.2	1.9	4.0	2.4	1.8	T	T	31.5
1951-52	0	T	T	5.8	3.0	6.8	2.7	0.4	2.2	1.9	1.4	T	18.1
1952	0	T	5.8	7.9	8.8	3.7							

MONTHLY AND SEASONAL DEGREE DAYS

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1944-45	-	-	-	-	-	-	-	-	-	1708	1378	728	-
1945-46	382	870	940	1880	2538	2068	2150	2349	2308	2164	1128	480	20465
1946-47	375	388	1098	1392	2018	2806	2744	2312	2486	2050	1387	878	20304
1947-48	344	872	998	1754	1938	2338	2783	2232	2390	1865	1488	786	19833
1948-49	813	662	1138	1703	2254	2982	2519	2800	2179	2338	1320	787	21185
1949-50	433	399	837	1310	1857	2367	2079	2827	2817	1877	1216	829	19463
1950-51	278	448	881	1354	1832	2818	3178	2622	2852	1862	1192	376	18717
1951-52	319	478	918	1873	1833	2354	2841	2049	2750	2131	1522	783	20738
1952	318	342	1104	1539	1850	2592							

STATION LOCATION

Location	Occupied from	Occupied to	Airline distance and direction from previous location	North Latitude	West Longitude	Elevation above: Sea level: Ground	Sea level: Actual barometer elevation (H_p)	Ground: Wind instruments	Ground: Extreme thermometers	Ground: Psychrometer	Ground: Telepsychrometer	Ground: Tipping bucket rain gage	Ground: Weighing rain gage	Ground: 8" rain gage			Remarks
UMIAT AIRPORT	4/1/45	11/15/52		69° 22'	152° 08'	337	340	31	4	4				3			1st Order Sta. closed. Data for bal. of yr. from CAA sta.

The exposure of the instruments, rain gage, and pibal observation point is excellent. Local surface winds may be influenced by local topography, but there are no apparent influences to prevent representative temperature readings. Pibal observation schedules have varied as follows: 8/17/47 to 4/28/48 0300Z & 1500Z; 4/30/48 to 5/11/48 1500Z; 5/12/48 to 5/30/48 1500Z & 2100Z; 6/1/48 to 8/31/48 0300Z & 1500Z; 9/1/48 to 10/20/48 1500Z & 2100Z; 10/20/48 to 12/21/48 0300Z & 1500Z; 1/1/49 to present 1500Z & 2100Z. The station is located about 1/8 mi. from the south side of the runway. The Colville River runs approximately 2 mi. E of the station, and Seabee Creek is 1/2 mi. north. The Brooks Range lies approximately 75 mi. to the south. Ground cover is tundra moss with a few willows along the streams.

NARRATIVE CLIMATOLOGICAL SUMMARY

The country surrounding Umiat is generally rolling, with a range of hills about 340 feet above the level of the station 1-1/4 miles to the north, and a range about 200 feet higher than the station 3-1/2 miles to the south. These hills tend to restrict surface winds to easterly and westerly directions. High winds are uncommon, and are generally from the east when they do occur. The area is predominantly tundra with a few willows along the river and smaller streams. The ground is permanently frozen to an average depth of 725 feet. The surface is somewhat swampy during the summer months, when the thaw penetrates to a depth of about 12 inches.

The monthly mean temperature is about 10°, with the daily maximum exceeding 70° about 2 weeks of the year, generally in July, and periods during the winter months when the daily minimum is below -50°. Light winds and clear skies predominate during periods of extreme cold. The greatest part of the annual precipitation falls in the form of snow.

The sun is below the horizon continuously from sunset on November 30th until the next sunrise on January 10th. The sun never sets from May 17th to July 25th.

REFERENCE NOTES

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation and snowfall in inches; wind movement in miles per hour; and relative humidity in percent.

Sky cover is expressed in a range of 0 for no clouds or obstructions to 10 for complete sky cover. Degree days are based on daily average temperatures of 65°F. Sleet and hail were included in snowfall totals, beginning with July 1948.

Data for earlier years may be obtained by contacting the Weather Bureau Office for which this publication was issued.

Heavy fog in the Means and Extremes table also includes data referred to at various times in the past as "Dense" or "Thick".

The upper visibility limit for heavy fog is 1/4 mile.

Below zero temperatures are preceded by a minus sign.

- * Less than one half.
- \- No record.
- • Also on earlier dates, months, or years.
- T Trace, an amount too small to measure.

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Table A-2 Average Black-Bulb Temperature, °F. for Umiat Base at 3 inches, June 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
25	37	37	37	37	38	41	48	53	57	60	62	67	63	61	61	57	56	53	53	52	49	42	39	39	1139	50
26	37	37	37	39	41	43	43	47	53	55	56	62	66	67	67	68	67	64	57	50	47	46	45	43	1237	52
27	41	39	38	38	39	42	47	49	55	61	64	64	67	69	71	74	74	73	70	60	52	45	42	40	1314	55
28	38	38	38	38	42	43	46	52	56	60	66	68	68	69	70	70	69	69	66	56	47	44	41	40	1294	54
29	39	38	38	38	39	40	41	42	43	44	45	48	53	54	55	54	51	48	45	41	39	39	40	39	1053	44
30	38	37	36	36	36	37	40	46	57	59	60	61	61	63	63	63	63	50	58	56	47	43	40	38	1198	50

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Table A-2 Average Black-Bulb Temperature, °F, for Umiat Base at 3 inches, July 1952

DATE	FOR HOUR ENDING AT: A.M. 1	2	3	4	5	6	7	8	9	10	11	12N	ALASKAN STANDARD TIME P.M. 1	2	3	4	5	6	7	8	9	10	11	12M	TOTAL	AVE.
1	37	37	36	36	37	37	39	41	42	46	51	59	65	66	69	69	67	64	61	56	47	43	37	37	1178	49
2	35	34	34	34	35	37	40	45	46	51	56	56	63	71	72	75	77	77	77	70	57	50	46	44	1282	53
3	39	37	36	45	61	69	76	80	85	87	88	90	85	83	75	77	77	72	74	70	65	60	56	51	1638	68
4	51	51	51	51	52	53	56	62	68	74	79	88	88	87	79	79	57	57	60	66	58	62	53	53	1540	64
5	51	47	46	50	61	71	79	84	85	87	92	92	93	90	86	85	82	65	74	70	62	51	55	50	1714	72
6	49	45	48	56	63	59	72	83	77	90	87	91	92	80	74	91	83	91	89	76	64	65	59	51	1735	72
7	53	52	53	53	55	59	65	75	75	78	81	92	86	84	86	82	78	73	70	66	63	61	58	55	1653	69
8	52	51	49	49	50	62	70	74	73	70	72	90	80	80	80	82	80	83	66	62	58	55	52	52	1543	64
9	52	53	51	52	56	58	59	64	76	69	66	64	64	70	71	72	68	67	66	62	59	56	52	46	1473	61
10	43	44	41	49	54	64	60	54	61	73	74	77	81	85	82	76	71	64	62	59	58	55	55	50	1492	62
11	48	50	49	48	56	70	75	82	87	93	89	82	93	93	90	91	86	79	76	70	68	64	56	55	1750	73
12	54	53	54	55	56	61	55	66	73	85	97	97	90	98	74	92	82	92	75	69	67	62	57	55	1719	72
13	48	47	50	56	58	61	60	64	80	81	83	91	87	87	94	83	82	79	73	69	65	62	60	58	1678	70
14	53	55	55	56	56	59	62	69	74	69	65	75	72	70	72	66	67	67	54	51	46	44	42	41	1440	60
15	39	39	39	39	39	41	41	42	45	46	52	62	75	71	73	63	68	65	57	50	48	46	45	44	1268	53
16	43	42	43	43	45	47	50	54	60	59	67	66	69	69	73	70	70	73	61	52	48	44	38	37	1323	55
17	36	32	35	40	45	56	64	63	68	73	83	82	86	86	90	95	95	89	84	65	53	46	40	34	1540	64
18	29	32	36	44	58	67	75	80	83	84	87	87	89	90	90	92	91	87	83	76	61	53	45	40	1659	69
19	46	43	41	50	64	71	76	79	81	78	81	83	82	63	67	70	71	69	66	60	55	53	48	45	1542	64
20	44	41	44	42	47	66	70	71	68	82	90	91	93	90	87	88	85	70	68	71	64	61	57	56	1646	69
21	56	56	56	56	55	55	56	57	57	57	58	59	59	59	58	60	61	59	58	58	57	56	54	54	1371	57
22	53	52	52	52	52	53	51	60	59	59	60	69	72	68	71	67	63	55	53	50	47	46	45	45	1360	51
23	45	44	43	43	43	43	48	48	50	55	65	74	77	77	78	79	78	73	56	50	47	42	38	40	1336	56
24	39	40	40	40	41	41	42	44	45	45	47	51	56	57	56	59	59	57	54	52	46	40	28	28	1106	46
25	26	30	37	41	41	54	65	64	72	75	78	79	80	81	83	84	85	84	78	65	49	44	36	36	1467	61
26	34	33	32	36	43	53	58	64	69	71	71	76	70	64	70	69	64	58	58	56	54	51	47	45	1288	54
27	46	46	48	51	57	55	56	58	59	60	67	69	69	65	64	66	64	63	65	53	49	47	44	43	1364	57
28	41	41	43	43	44	44	44	44	45	47	47	49	50	51	51	49	49	47	47	46	45	45	45	44	1101	46
29	43	43	43	44	45	46	48	52	55	55	56	56	61	58	59	57	56	53	51	46	43	41	39	39	1189	50
30	39	39	40	40	41	42	45	47	53	65	70	65	70	72	74	62	62	56	54	50	44	39	40	40	1249	52
31	39	41	42	43	47	50	68	76	80	81	87	80	83	84	75	76	63	59	56	51	47	44	42	44	1458	61

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Table A-2 Average Black-Bulb Temperature, °F. for Umiat Base at 3 inches, August 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	44	45	45	45	46	48	50	55	56	68	72	80	85	87	78	90	76	65	59	55	52	48	41	38	1473	61
2	42	43	45	46	52	63	58	62	62	66	67	80	78	72	68	72	63	58	53	55	56	55	54	54	1423	59
3	54	53	52	50	53	57	63	57	60	60	58	55	57	55	54	57	62	72	65	54	50	43	44	45	1330	55
4	46	45	47	47	50	53	56	66	69	71	68	63	65	63	66	65	61	59	59	56	52	51	50	48	1376	57
5	47	46	46	46	47	51	62	64	70	73	73	74	74	75	75	79	78	69	65	55	45	42	40	38	1434	60
6	32	30	34	40	45	48	55	69	66	79	87	90	93	97	100	101	95	89	80	66	59	43	40	37	1575	66
7	34	35	35	41	55	68	74	79	85	84	85	85	87	89	90	90	86	82	76	64	54	42	36	37	1593	66
8	31	30	31	40	53	64	75	81	85	87	90	92	93	97	97	83	73	81	76	67	61	57	51	49	1644	69
9	49	47	42	45	52	62	73	78	84	88	90	92	95	97	93	80	74	62	65	57	56	54	54	56	1641	68
10	51	51	49	49	50	53	56	68	74	77	87	87	83	79	77	69	65	63	60	59	56	53	52	52	1520	63
11	54	50	48	47	47	48	50	54	56	57	57	62	68	67	63	63	61	65	60	58	56	55	54	53	1353	56
12	52	51	51	51	50	50	51	51	53	55	54	54	55	56	58	60	59	58	56	54	50	49	49	49	1276	53
13	49	48	49	50	49	50	50	52	54	57	57	62	64	68	66	66	62	53	50	49	47	46	45	45	1286	54
14	45	44	43	42	42	44	45	46	47	49	47	47	51	57	55	53	53	49	46	42	40	37	37	37	1098	46
15	35	35	35	35	36	38	42	48	55	58	69	49	51	56	62	66	62	63	57	47	40	37	38	32	1145	48
16	31	31	29	29	31	36	38	40	44	48	56	63	65	68	74	76	74	73	65	52	45	40	39	41	1188	50
17	41	41	40	40	41	41	44	48	54	63	70	72	72	73	74	73	63	63	58	52	48	44	43	41	1299	54
18	40	39	37	37	37	38	39	43	46	48	48	51	53	50	48	49	47	46	43	41	40	38	37	35	1030	43
19	35	35	35	35	35	36	38	39	43	42	43	46	49	48	47	47	46	41	39	37	35	34	33	33	951	40
20	32	32	31	31	31	32	32	35	39	41	43	45	46	46	45	45	44	42	39	36	34	31	30	29	891	37
21	28	27	27	27	27	28	30	32	38	45	56	57	61	61	61	61	63	60	52	40	33	30	21	21	986	41
22	27	28	29	27	27	29	31	33	38	43	47	52	61	61	65	65	69	59	49	44	35	31	26	28	1004	42
23	31	33	32	33	35	37	39	42	50	62	64	65	67	67	59	57	57	54	42	39	37	36	35	35	1108	46
24	35	35	34	33	33	32	32	32	32	33	35	37	39	39	38	38	37	37	35	35	34	33	33	33	834	35
25	32	32	32	32	33	34	36	38	39	41	42	43	44	45	45	44	42	40	40	38	37	35	35	34	913	38
26	33	33	33	33	33	33	37	40	45	54	51	51	66	58	58	54	46	43	42	37	33	26	22	15	975	41
27	14	14	14	17	24	35	44	44	60	64	64	70	73	77	79	80	77	70	50	25	27	32	32	30	1116	47
28	25	23	20	20	26	35	48	46	62	69	68	70	73	75	76	76	71	65	51	40	32	34	33	33	1171	49
29	35	35	35	35	35	36	37	40	46	53	53	53	60	63	60	53	57	57	46	34	28	28	29	31	1096	46
30	33	33	33	34	34	36	40	42	44	49	53	53	53	53	54	51	48	45	41	38	37	37	35	34	1031	43
31	34	34	34	34	33	34	35	37	39	40	40	41	49	51	50	48	46	42	38	34	32	29	27	27	908	38

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Table A-2 Average Black-Bulb Temperature, °F, for Umiat Base at 3 inches, September 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	25	26	26	25	25	27	30	32	36	40	46	50	58	56	56	62	55	45	41	39	37	35	33	33	938	39
2	33	32	32	32	31	31	32	33	34	35	38	42	46	49	50	53	46	43	41	39	35	34	32	33	907	38
3	33	32	32	32	32	32	32	32	33	35	37	38	44	45	43	44	36	33	31	30	30	30	30	30	826	34
4	29	29	29	28	26	27	30	31	34	38	41	43	43	42	37	35	33	32	32	31	30	30	30	27	787	33
5	26	25	24	25	26	27	28	28	28	31	33	35	34	34	35	40	32	27	25	23	24	24	24	23	681	28
6	23	23	23	23	24	27	30	32	36	36	37	37	37	37	37	37	38	36	34	32	33	32	32	31	765	32
7	31	31	32	31	30	30	31	32	36	37	38	39	41	42	41	49	60	46	29	21	15	11	12	13	768	32
8	14	15	17	17	18	19	23	25	35	40	37	40	41	44	45	46	45	34	31	26	25	24	27	28	716	30
9	28	27	27	27	27	27	27	29	31	33	35	35	37	39	39	37	35	33	32	30	29	27	27	29	747	31
10	29	28	28	28	27	27	28	29	31	33	37	37	40	38	37	37	35	32	30	28	28	28	28	28	751	31
11	27	27	27	27	27	27	27	29	31	32	36	36	36	36	35	34	32	30	29	28	28	28	27	27	722	30
12	27	26	26	26	26	25	26	28	31	36	37	37	42	46	49	47	50	41	25	16	13	10	13	14	717	30
13	15	15	16	16	16	17	20	23	29	38	46	49	51	54	54	50	44	32	21	19	26	28	29	29	737	31
14	30	30	30	29	29	30	30	30	31	32	33	33	35	34	34	34	33	32	32	32	32	32	32	32	761	32
15	31	31	31	31	30	31	32	32	33	34	35	35	36	35	35	34	33	33	32	32	31	31	30	29	776	32
16	29	29	29	29	28	28	28	30	32	36	38	39	40	41	38	36	35	33	31	29	29	29	29	29	774	32
17	29	29	29	28	28	28	29	30	32	32	32	34	34	35	34	32	30	29	27	29	29	29	29	29	731	30
18	29	29	30	30	26	25	28	30	32	36	38	40	41	39	36	38	33	31	28	27	25	21	22	21	735	31
19	17	16	23	23	23	23	25	28	30	36	37	38	42	43	43	42	38	32	30	28	22	17	15	15	686	29
20	18	21	21	22	18	18	22	26	32	37	43	49	54	47	43	40	36	23	23	22	23	23	19	15	695	29
21	20	19	21	23	24	25	26	29	30	31	31	33	34	34	33	32	31	30	30	30	30	29	30	30	685	28
22	30	31	32	32	31	30	31	32	33	36	37	36	36	35	33	33	31	31	31	31	31	31	31	31	776	32
23	31	31	31	32	32	32	32	32	32	33	35	36	36	34	34	33	32	30	30	30	29	29	30	29	765	32
24	29	29	28	28	27	26	27	31	32	33	36	36	37	35	35	31	29	29	28	27	27	26	26	26	718	30
25	26	25	25	24	23	23	24	24	25	27	29	31	31	29	28	27	26	26	26	26	26	26	26	26	629	26
26	28	28	28	25	28	28	25	26	27	28	29	30	29	29	28	27	27	27	26	26	26	25	25	25	650	27
27	25	25	25	25	25	25	25	26	27	28	29	28	29	30	29	27	25	24	23	23	22	22	22	22	611	25
28	22	21	21	21	20	20	21	21	22	23	23	24	25	22	21	19	18	17	16	16	16	16	17	17	479	20
29	17	17	17	17	18	19	20	21	24	26	29	27	26	23	22	21	19	19	18	18	18	18	18	18	490	20
30	18	18	18	18	18	19	20	23	24	26	25	30	26	25	22	16	18	19	19	19	19	19	19	20	517	22

Occasionally snow-covered after the 2nd.

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Table A-3 Average Black-Bulb Temperature, °F, for Site 1 at 8 feet, June 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
28	35	35	35	35	36	41	46	49	58	62	65	70	72	73	72	70	69	66	60	48	45	40	39	37	1258	52
29	37	36	35	35	36	37	39	41	42	43	45	50	52	54	54	52	48	45	41	38	37	38	37	36	1008	42
30	35	34	34	34	34	37	42	56	63	66	69	71	73	73	72	70	66	61	55	42	39	38	36	35	1235	51

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Table A-3 Average Black-Bulb Temperature, °F, for Site 1 at 8 feet, July 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	35	34	34	34	35	35	38	40	40	47	56	64	67	70	71	73	70	65	58	42	39	35	34	33	1149	48
2	31	31	31	33	35	36	39	41	47	51	51	59	70	72	73	73	73	73	70	51	47	44	42	38	1211	50
3	37	38	38	40	42	60	66	73	77	82	86	84	82	76	73	73	72	69	69	64	60	57	54	52	1525	64
4	51	50	50	50	51	52	56	62	67	72	82	89	91	86	81	73	55	57	62	60	57	57	53	51	1515	63
5	50	49	46	46	48	57	70	78	83	88	91	92	92	90	80	86	89	65	73	67	62	60	57	53	1672	70
6	52	51	50	54	55	56	65	74	74	84	86	93	95	82	82	100	86	83	83	65	60	60	58	57	1705	71
7	56	56	55	55	55	57	63	73	73	83	87	88	87	84	81	78	72	69	66	64	61	60	57	53	1633	68
8	52	52	51	50	53	60	66	71	70	67	68	84	80	78	76	77	77	75	62	60	57	54	53	51	1544	64
9	52	52	53	53	55	57	59	66	69	64	63	62	64	67	68	69	63	64	62	59	58	56	52	51	1438	60
10	51	50	46	46	47	56	57	53	63	67	69	75	75	80	74	71	68	61	60	57	56	55	53	51	1440	60
11	50	50	48	47	47	50	68	73	80	85	88	81	93	93	88	85	78	73	71	66	64	63	60	58	1659	69
12	57	55	54	54	55	58	60	62	69	75	83	92	83	97	80	82	92	90	80	68	65	62	58	56	1687	70
13	55	54	52	54	56	59	60	62	70	75	83	92	89	83	83	80	80	77	73	68	64	61	58	57	1645	69
14	57	55	55	55	54	55	56	63	68	67	62	68	70	67	68	63	63	64	52	48	45	41	40	38	1376	57
15	37	36	36	36	36	38	39	38	40	42	44	60	72	68	65	58	63	60	55	47	46	44	42	41	1143	48
16	40	40	40	41	42	45	47	50	56	59	66	67	71	71	71	68	69	67	65	53	46	44	41	39	1298	54
17	38	37	37	39	41	46	55	58	60	68	80	84	85	83	87	91	90	81	76	57	54	50	47	46	1490	62
18	43	42	39	39	41	46	65	70	76	80	85	87	89	89	89	87	85	82	77	64	61	58	55	52	1601	67
19	52	50	48	49	49	56	70	73	78	72	78	77	77	63	65	69	72	65	62	56	51	49	47	47	1475	61
20	47	46	46	46	47	53	69	71	75	83	88	91	90	80	80	83	73	66	66	65	60	58	55	56	1594	66
21	56	56	55	55	53	53	53	54	54	55	55	56	57	56	57	59	57	56	55	54	53	51	51	50	1311	55
22	49	49	49	49	49	49	52	56	56	57	59	66	65	62	64	60	59	52	50	46	45	44	43	43	1268	53
23	42	41	41	40	40	42	45	45	52	60	71	74	77	78	77	79	77	70	53	47	45	39	36	37	1308	55
24	37	37	37	37	38	39	40	40	40	42	43	49	50	51	52	56	51	51	49	47	42	38	38	38	1042	43
25	38	37	37	39	39	40	50	63	70	75	77	80	81	83	83	83	81	77	72	49	45	41	39	36	1415	59
26	35	33	33	33	35	40	55	61	69	75	77	79	70	66	63	72	65	61	55	55	53	51	49	47	1332	56
27	44	44	45	46	50	52	52	54	55	57	57	66	66	63	60	60	61	58	58	52	48	46	43	42	1279	53
28	41	39	39	40	40	42	41	41	41	45	46	46	47	49	50	48	47	46	45	43	43	42	41	41	1043	43
29	40	40	40	41	42	43	45	46	52	51	52	51	55	56	58	62	53	53	48	45	41	40	38	37	1129	47
30	37	36	37	38	39	40	41	43	47	60	65	61	61	64	65	61	57	57	54	48	46	40	40	42	1179	49
31	41	40	40	41	41	44	55	63	72	78	77	77	79	84	82	68	61	59	54	51	46	45	43	44	1389	58

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Table A-3 Average Black-Bulb Temperature, °F, for Site 1 at 8 feet, August 1952

DATE	FOR HOUR ENDING AT: A.M. 1	2	3	4	5	6	7	8	9	10	11	12N	ALASKAN STANDARD TIME P.M. 1	2	3	4	5	6	7	8	9	10	11	12M	TOTAL	AVE.
1	43	43	43	44	44	45	47	50	51	61	73	80	85	85	78	80	75	64	57	55	53	51	49	46	1402	58
2	45	44	44	45	47	51	55	56	60	61	61	67	82	75	68	65	64	61	62	56	55	55	53	52	1384	51
3	52	52	52	51	50	52	54	58	55	56	55	53	52	53	51	52	55	60	58	55	49	47	45	45	1262	53
4	46	46	46	45	45	46	48	50	52	54	55	58	58	60	59	59	58	58	58	56	53	49	47	46	1232	51
5	45	44	44	44	44	45	49	60	61	74	78	81	80	82	78	80	80	74	68	53	49	47	44	43	1447	60
6	40	38	35	36	40	43	45	54	51	73	81	88	93	95	95	97	96	93	89	86	62	59	56	54	1579	66
7	49	49	48	45	45	47	53	71	78	85	89	91	94	94	95	97	93	88	82	62	58	52	51	51	1667	69
8	46	44	43	42	43	44	50	70	77	85	89	93	94	95	96	86	74	69	72	65	62	60	58	55	1612	67
9	53	52	50	48	47	48	59	71	77	86	89	92	94	98	96	90	74	62	65	56	55	56	56	55	1628	68
10	55	55	54	53	53	54	57	63	72	78	86	84	78	76	74	65	62	61	58	55	49	47	45	45	1479	62
11	46	46	46	46	47	49	51	54	63	63	62	61	63	62	59	59	58	58	56	55	53	52	51	50	1310	59
12	50	49	48	48	47	47	49	49	50	51	51	51	52	54	55	57	57	54	52	51	49	49	49	49	1218	51
13	47	47	47	47	47	47	48	50	50	54	57	60	62	62	60	60	56	50	48	46	44	44	43	43	1219	51
14	43	41	40	40	40	41	43	43	45	45	45	46	52	56	51	50	52	43	40	37	35	34	34	34	1030	43
15	33	33	33	33	33	35	39	49	45	61	65	55	70	60	60	70	65	63	45	47	38	36	37	33	1138	47
16	32	31	30	29	30	35	38	39	42	47	59	69	73	77	76	76	73	69	49	47	45	44	44	42	1196	50
17	41	40	40	39	39	41	45	51	59	67	75	76	80	80	89	63	63	60	49	45	43	40	39	36	1291	54
18	36	35	35	35	35	37	40	43	45	45	49	53	48	48	47	45	42	40	38	37	36	34	33	33	969	40
19	32	32	32	33	33	35	37	40	40	41	44	46	46	45	45	42	38	36	33	33	31	30	30	30	885	37
20	29	29	29	29	30	30	32	35	38	47	45	47	48	46	45	43	42	40	37	34	31	29	28	26	869	36
21	25	25	24	24	25	25	25	30	42	52	55	61	62	68	68	68	65	61	53	33	28	27	27	26	1000	42
22	25	25	25	25	24	26	28	30	36	45	49	54	58	63	64	63	62	51	46	45	40	38	37	34	993	41
23	33	35	34	34	35	36	37	41	52	63	68	76	79	71	57	57	58	56	44	37	36	34	33	33	1139	47
24	32	32	31	31	31	30	30	30	30	30	32	33	35	37	37	36	36	35	35	33	32	32	31	31	782	33
25	30	30	30	30	30	31	33	35	37	38	40	41	43	44	44	43	42	39	38	36	35	34	33	32	868	36
26	31	31	31	30	30	30	33	36	40	42	45	48	59	53	53	55	44	43	41	40	35	34	32	29	945	39
27	29	27	26	26	25	25	25	32	50	60	63	68	71	72	79	78	78	77	70	55	46	43	39	38	1202	50
28	36	36	35	31	30	30	32	39	43	61	69	72	74	75	75	73	73	74	67	50	41	37	34	32	1219	51
29	32	32	32	32	32	32	32	35	37	43	53	52	54	63											561	40

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Table A-4 Average Black-Bulb Temperature, °F, for Site 2 at 17 inches, June 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
29*	37	36	36	36	36	38	39	41	43	44	46	48	52	54	56	54	49	45	43	39	38	38	38	37	1023	43
30	36	35	35	34	34	36	40	50	65	69	70	74	75	77	75	70	58	53	46	43	40	39	37	36	1227	51

* Veg probably melted out from beneath snowbank by 29th.

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Table A-4 Average Black-Bulb Temperature, °F, for Site 2 at 17 inches, July 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	35	35	34	34	35	36	38	40	41	46	53	65	71	73	74	74	63	54	47	43	40	37	34	34	1136	47
2	32	32	32	33	35	37	39	41	47	51	52	60	66	79	79	74	65	60	55	51	48	44	41	38	1191	50
3	36	37	38	39	41	52	64	68	77	83	90	86	86	76	73	73	70	68	64	62	58	55	53	51	1500	63
4	50	50	50	51	52	54	59	65	70	80	93	96	93	81	86	57	56	57	60	56	58	54	50	50	1528	64
5	49	48	47	47	50	64	73	74	82	89	93	93	90	80	84	81	64	67	67	62	60	57	54	51	1626	68
6	51	49	49	54	55	59	69	71	81	87	97	97	84	77	86	78	73	72	63	59	59	57	56	56	1639	68
7	56	55	55	55	56	60	68	72	79	82	89	84	80	79	73	72	70	67	64	61	60	56	55	51	1599	67
8	51	51	49	52	58	63	69	66	64	65	89	81	77	73	71	69	66	62	60	57	55	53	52	52	1505	63
9	53	52	53	55	56	57	62	65	63	62	61	63	66	66	66	62	62	60	58	57	56	52	51	51	1409	59
10	50	45	44	47	53	56	52	60	64	67	73	75	80	70	69	66	61	59	56	56	53	52	50	49	1397	58
11	49	47	47	47	50	60	72	72	76	84	84	95	92	81	77	73	71	68	66	63	60	58	57	55	1604	67
12	54	54	54	56	57	59	61	68	72	86	87	90	96	74	75	74	73	70	64	63	60	57	57	55	1616	67
13	53	52	55	56	59	59	61	68	72	86	90	90	80	80	77	75	73	70	66	61	60	57	56	56	1612	67
14	55	55	55	55	56	58	63	67	65	62	72	68	67	67	62	62	62	52	49	45	42	40	39	37	1355	56
15	37	37	37	38	40	40	40	42	43	50	70	76	63	56	55	54	52	49	47	45	43	42	41	41	1138	47
16	40	41	41	43	45	48	52	56	61	67	72	73	71	62	60	57	56	53	48	46	44	42	40	39	1257	52
17	37	37	40	41	47	52	55	59	72	77	87	87	86	78	76	74	70	65	60	53	50	47	46	44	1440	60
18	41	40	39	39	41	47	56	65	67	73	81	88	91	90	80	75	73	70	66	61	58	55	51	51	1498	62
19	51	49	47	48	48	53	63	69	73	74	77	74	72	60	65	67	64	62	60	54	51	48	46	46	1421	59
20	46	46	46	46	47	50	60	66	68	79	87	98	76	78	76	74	69	65	65	62	60	57	55	55	1531	64
21	55	55	55	54	53	53	54	54	54	55	56	56	58	57	58	59	57	56	56	54	54	51	51	50	1315	55
22	49	49	49	49	49	50	52	56	56	56	59	65	65	61	64	60	59	52	50	47	45	44	43	43	1272	53
23	42	41	41	40	40	42	45	45	52	61	72	74	78	78	77	79	77	70	53	47	45	29	35	37	1310	55
24	37	38	38	37	38	39	40	40	40	42	43	49	50	51	52	56	52	51	50	47	41	38	38	38	1045	44
25	38	37	37	39	39	40	50	63	70	75	77	80	81	83	83	83	81	78	73	49	45	41	39	36	1417	59
26	35	33	33	33	34	40	45	61	69	75	77	79	70	66	63	67	64	61	55	54	53	52	49	47	1280	53
27	45	45	45	46	49	52	52	54	55	56	58	68	70	63	61	59	59	57	56	50	48	46	44	42	1315	55
28	41	39	40	41	41	42	42	42	42	45	47	47	48	49	51	49	48	47	46	45	44	43	42	41	1062	44
29	41	41	41	42	42	44	45	46	52	51	52	51	55	54	58	56	52	50	46	44	42	40	39	37	1121	47
30	37	38	38	38	39	40	41	43	47	59	63	57	61	59	60	59	55	52	50	47	44	39	41	43	1150	48
31	42	41	41	41	42	44	49	56	61	70	71	82	77	84	68	63	58	57	52	51	46	44	44	44	1328	55

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Table A-4 Average Black-Bulb Temperature, °F, for Site 2 at 17 inches, August 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	44	44	44	44	45	46	48	51	52	63	71	86	86	84	68	64	61	58	56	54	52	50	47	45	1363	57
2	45	45	45	46	48	53	53	57	57	59	60	78	74	66	63	62	60	58	55	53	54	53	51	51	1346	56
3	52	52	51	51	52	53	57	56	55	59	54	52	53	52	50	52	55	58	54	51	48	46	44	45	1252	52
4	46	46	46	46	47	48	50	53	54	53	58	57	59	57	58	58	58	56	55	53	50	48	47	45	1248	52
5	45	44	44	44	45	48	52	57	61	70	86	85	87	82	64	64	62	58	55	52	49	49	49	48	1440	58
6	48	48	48	48	48	49	50	54	62	71	88	94	98	95	84	79	74	69	65	64	59	56	53	50	1554	65
7	48	48	47	46	47	50	59	67	73	80	91	98	99	97	83	78	74	68	63	60	52	50	49	48	1575	66
8	45	43	43	43	44	48	56	65	70	81	96	99	98	94	80	73	67	67	64	62	59	58	55	54	1564	65
9	51	50	47	47	48	51	59	65	74	88	96	97	98	94	80	71	61	59	56	55	55	56	55	55	1568	65
10	55	55	54	53	53	54	58	62	69	82	83	77	75	73	64	61	60	59	58	56	55	54	52	52	1474	61
11	49	47	47	46	48	50	52	56	60	61	62	63	62	58	59	59	59	58	55	53	52	51	51	51	1309	55
12	50	49	48	48	48	49	49	51	52	52	52	53	54	56	58	55	54	53	51	49	48	46	45	43	1213	51
13	39	37	36	39	41	44	47	51	53	53	53	59	59	60	57	57	55	50	48	47	45	45	45	44	1164	49
14	44	42	41	41	41	41	43	43	44	46	45	47	52	53	52	49	49	45	42	39	37	35	35	35	1041	43
15	34	34	34	34	34	35	38	43	43	50	59	52	80	78	51	54	52	45	43	41	40	38	38	35	1085	45
16	32	32	30	29	29	34	37	37	41	45	61	78	81	80	63	60	58	53	48	46	45	43	43	42	1147	48
17	41	40	40	40	39	42	44	48	56	61	74	82	85	84	68	60	58	53	49	45	42	41	39	37	1268	53
18	37	35	35	35	36	37	40	41	44	45	48	53	48	48	47	45	43	41	39	38	37	35	34	34	975	41
19	33	33	33	33	34	36	38	41	40	41	45	46	46	45	44	41	39	37	34	33	32	31	31	30	896	37
20	30	30	30	30	31	31	33	36	38	48	44	43	46	45	44	43	42	40	37	35	32	30	29	28	879	37
21	27	26	26	26	26	26	26	29	36	42	47	62	72	76	73	57	50	45	40	35	30	28	27	25	957	40
22	24	25	25	25	25	26	28	30	34	42	45	55	65	66	63	55	54	50	46	43	41	39	37	34	977	41
23	34	34	34	34	35	36	37	42	52	58	64	84	87	66	57	56	54	50	41	38	37	35	34	33	1132	47
24	33	33	33	32	31	31	31	31	31	31	32	33	35	37	37	37	36	35	35	34	33	32	32	31	796	33
25	31	31	31	31	31	32	33	36	37	39	40	41	44	44	44	43	41	39	38	36	35	34	33	32	876	37
26	32	32	32	31	31	32	33	34	40	44	45	63	55	51	50	47	42	40	39	36	34	31	30	28	952	39
27	27	26	26	25	25	27	33	41	51	56	74	80	82	81	64	61	57	52	44	41	40	38	37	36	1124	47
28	37	35	32	30	31	33	40	47	58	63	74	81	81	71	68	64	56	51	45	39	35	33	32	32	1168	49
29	33	33	33	33	33	34	36	39	46	51	end														371	37

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Table A-5 Average Black-Bulb Temperature, °F, for Site 3 at 3 inches, June 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
29	37	35	34	34	34	34	36	36	38	40	41	45	49	50	51	50	48	45	42	39	36	36	37	36	966	40
30	35	34	33	33	33	33	36	42	54	56	57	58	59	59	58	58	57	55	53	50	46	40	36	35	1100	46

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Table A-5 Average Black-Bulb Temperature, °F, for Site 3 at 3 inches, July 1952

	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.													
DATE	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M	TOTAL	AVE.
1	34	34	33	33	33	34	35	37	37	40	46	56	65	62	60	62	60	57	55	51	47	41	34	33	1079	45
2	31	31	31	31	34	34	36	39	43	49	53	54	60	65	66	69	71	71	68	64	58	52	46	39	1194	90
3	37	41	47	51	58	68	73	77	80	81	84	84	79	76	69	72	71	69	72	64	61	58	52	52	1576	66
4	50	50	50	50	53	53	58	66	70	74	85	86	88	84	82	66	53	57	62	60	59	62	54	50	1520	63
5	49	51	53	58	64	72	80	80	83	87	88	89	89	84	79	80	74	67	72	66	60	57	56	54	1691	70
6	53	53	54	62	65	60	75	77	80	83	87	88	90	76	80	92	80	84	78	72	69	65	58	55	1735	72
7	54	54	55	54	56	63	70	78	84	81	87	82	78	86	82	79	71	67	66	63	60	58	55	53	1636	68
8	52	51	49	50	60	74	71	76	64	71	80	75	80	76	75	79	77	69	61	57	55	52	51	51	1556	69
9	52	52	52	54	56	58	62	70	65	64	63	62	68	68	72	66	63	64	61	59	56	53	50	50	1439	60
10	49	46	50	59	60	61	53	62	68	71	73	73	74	74	70	68	62	60	58	57	56	55	50	48	1467	61
11	51	51	51	57	67	75	77	80	86	86	80	87	88	85	85	80	76	73	69	66	62	59	57	55	1702	71
12	54	54	54	57	59	62	65	72	76	84	88	86	93	76	82	86	87	79	74	69	66	60	58	56	1687	71
13	51	51	59	58	62	62	62	74	78	81	87	86	83	85	81	80	76	72	67	63	61	58	58	56	1651	69
14	54	55	54	55	57	60	67	70	67	63	72	69	67	67	64	65	65	52	48	45	41	40	38	37	1392	58
15	36	36	36	37	39	40	40	42	43	48	60	68	66	62	62	63	67	63	59	52	50	47	45	44	1206	50
16	44	43	43	44	46	48	51	55	60	63	67	67	70	69	72	69	72	73	62	58	58	49	45	41	1369	57
17	40	37	39	43	46	60	65	64	69	80	81	85	86	86	86	93	92	82	80	67	58	55	49	46	1587	66
18	42	41	47	51	58	64	70	76	78	80	84	85	86	86	87	87	86	85	80	76	72	64	55	53	1691	70
19	54	53	54	60	66	72	75	77	79	75	80	78	76	62	68	71	72	67	65	58	55	51	50	49	1567	65
20	49	49	50	55	65	73	77	77	77	85	89	91	87	81	81	83	74	70	72	68	64	62	59	59	1697	71
21	59	60	59	58	57	57	58	58	58	59	60	60	61	60	63	63	60	60	59	58	56	55	55	54	1407	59
22	53	53	52	52	53	54	58	62	59	60	62	69	67	67	68	63	60	54	52	49	48	47	47	46	1355	56
23	45	45	44	44	43	46	51	49	55	62	68	70	71	72	72	72	72	66	53	49	50	43	40	40	1322	55
24	40	41	41	41	41	42	43	43	44	46	47	54	54	56	56	59	55	54	53	51	46	46	39	39	1131	47
25	39	40	41	47	47	61	61	66	71	72	73	75	77	78	80	80	79	78	67	62	55	47	41	41	1474	61
26	36	35	39	47	52	58	61	67	71	74	76	71	74	70	71	76	70	65	59	58	56	54	52	49	1441	60
27	47	48	48	52	55	57	56	57	59	61	62	68	66	64	63	62	62	61	61	55	52	50	47	46	1359	57
28	44	42	43	44	44	45	44	45	45	47	48	49	50	51	54	51	50	49	49	47	46	46	45	44	1121	47
29	44	44	44	45	46	48	50	51	58	56	57	56	61	58	60	60	55	54	51	47	44	43	41	40	1213	51
30	40	40	40	41	42	43	44	47	51	63	69	66	68	68	68	63	62	60	57	58	49	42	41	44	1266	53
31	42	43	43	44	45	50	62	73	77	80	77	80	82	83	78	72	64	60	56	54	49	48	47	47	1456	61

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Table A-5 Average Block-Bulk Temperature, °F, for Site 3 at 3 inches, August 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.													
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M	TOTAL	AVE.
1	47	47	47	48	49	50	53	58	58	74	76	83	81	84	80	79	74	65	61	58	55	53	50	47	1477	62
2	47	47	47	49	54	65	60	64	62	66	67	80	77	73	69	68	66	63	58	57	58	57	55	54	1463	61
3	55	54	53	54	56	58	63	59	60	60	58	56	57	56	55	57	61	62	61	57	56	50	48	49	1355	56
4	49	49	49	49	50	52	56	57	58	60	65	62	63	61	62	61	61	61	61	57	53	52	50	49	1347	56
5	48	48	47	47	48	51	64	64	67	74	74	74	74	72	72	76	74	69	67	59	50	47	46	42	1454	61
6	40	38	39	44	51	53	56	67	74	79	85	88	90	93	93	93	90	87	81	76	64	58	56	51	1646	69
7	49	50	49	59	66	72	76	84	85	86	86	86	88	89	89	86	84	81	77	70	59	52	52	50	1725	72
8	45	44	45	56	64	68	78	83	86	88	91	91	92	93	89	80	72	78	74	67	63	60	58	56	1721	72
9	55	52	50	56	62	71	74	78	84	86	90	92	92	91	85	75	63	69	64	60	58	59	58	58	1682	70
10	58	58	57	56	56	59	69	73	77	86	85	81	80	76	69	65	65	70	69	65	59	56	55	55	1599	66
11	51	50	50	52	55	58	66	70	69	69	68	67	65	64	65	65	65	60	57	56	55	54	54	54	1439	60
12	52	51	51	51	53	53	55	55	55	55	55	56	58	61	62	58	57	55	54	52	52	52	51	51	1303	54
13	51	51	51	52	52	51	54	57	59	59	60	64	66	66	65	64	59	53	51	49	47	47	47	47	1322	55
14	46	46	44	44	44	46	47	47	49	49	48	49	54	55	53	53	53	47	43	41	39	38	38	37	1109	46
15	36	36	36	36	37	39	46	56	49	65	63	62	66	60	67	66	63	61	56	48	40	38	39	34	1199	50
16	34	33	31	33	42	40	40	42	47	53	61	65	70	73	73	72	68	61	57	50	47	46	46	44	1228	51
17	43	43	43	41	43	47	52	58	69	71	72	72	76	77	63	62	62	55	50	47	45	43	41	40	1314	55
18	38	38	38	38	39	41	45	48	49	50	53	51	49	50	48	45	44	42	41	39	38	37	36	36	1033	43
19	36	36	36	36	37	39	41	42	42	45	47	47	47	46	44	41	39	37	36	35	33	33	33	33	894	37
20	32	32	32	32	33	33	34	37	40	46	45	46	46	46	46	44	42	39	36	34	32	31	29	28	895	37
21	27	27	27	27	28	29	33	48	53	55	57	58	58	59	58	57	54	52	45	33	30	29	27	27	998	42
22	28	26	27	27	31	33	35	39	47	49	56	57	60	61	61	63	55	50	45	41	36	35	34	35	1030	43
23	38	37	37	38	41	40	44	52	58	62	65	66	61	57	57	56	52	45	40	39	37	36	36	36	1130	42
24	35	35	34	34	33	33	33	33	33	34	35	36	38	39	38	38	37	37	36	35	35	34	34	34	843	35
25	33	33	33	34	34	36	38	39	40	42	43	46	46	46	46	42	41	40	39	38	37	35	35	34	926	39
26	34	34	34	33	37	39	39	44	50	48	58	58	56	57	50	46	43	41	38	37	33	31	29	28	995	41
27	27	27	26	35	45	50	57	61	64	66	67	70	73	74	76	72	68	60	46	42	39	30	38	39	1250	52
28	38	36	33	37	44	51	59	63	66	69	70	70	69	73	71	62	62	52	42	39	37	38	35	35	1250	52
29	35	35	35	35	36	39	42	48	52																357	40
30																										
31																										

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Table A-6 Average Black-Bulb Temperature, °F, for Site 4 at 3 inches, June 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	2	4	5	6	7	8	9	10	11	12M		
29	37	36	35	35	35	37	38	39	41	43	46	48	52	53	53	51	49	46	42	39	37	37	37	36	1001	42
30	35	34	34	33	34	35	40	47	58	60	61	61	61	59	58	59	55	54	54	53	50	40	37	36	1146	48

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Table A-6 Average Black-Bulb Temperature, °F, for Site 4 at 3 inches, July 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	35	35	34	34	34	35	36	38	39	43	39	62	65	61	60	60	59	57	56	54	50	46	35	33	1110	46
2	32	31	31	32	35	36	39	41	46	52	55	57	63	64	64	65	67	69	68	66	62	56	46	39	1216	51
3	36	44	50	54	60	69	76	80	86	89	90	88	79	76	75	71	75	70	70	72	64	60	57	50	1641	68
4	51	50	50	50	50	54	55	60	68	71	77	87	89	86	83	79	56	56	59	61	57	64	65	52	1530	64
5	50	49	53	57	60	65	75	84	87	92	95	95	95	94	86	78	79	69	67	73	66	59	57	56	1741	72
6	53	53	54	56	63	66	65	79	81	86	86	90	89	86	75	83	96	80	87	77	73	70	68	54	1760	73
7	52	52	53	53	54	56	64	74	82	89	85	94	85	81	86	81	78	71	68	65	62	60	58	55	1658	69
8	52	52	50	49	49	58	76	70	79	65	74	80	77	80	79	76	80	77	69	61	57	55	50	49	1564	65
9	49	51	51	52	54	56	58	63	75	68	66	64	62	70	70	72	68	63	65	32	59	56	51	49	1454	61
10	49	48	47	51	60	62	62	53	62	68	73	76	76	76	80	70	66	61	60	56	58	55	54	48	1471	61
11	48	49	57	48	64	70	77	78	82	90	87	88	88	86	83	81	79	77	68	68	63	60	56	54	1701	71
12	54	54	54	55	59	63	64	70	76	73	87	86	88	86	70	83	76	82	73	69	69	65	58	57	1671	70
13	51	49	56	59	61	64	62	66	81	81	88	84	83	80	83	82	77	74	70	65	62	59	58	57	1652	69
14	54	54	54	54	56	59	64	71	70	64	70	72	68	68	66	65	67	56	50	47	43	41	39	38	1390	58
15	37	36	36	37	38	40	39	42	43	46	58	67	67	66	60	60	60	57	54	49	46	44	42	41	1165	49
16	41	40	41	41	43	46	49	53	58	58	63	63	64	62	63	62	62	66	58	54	55	48	40	36	1208	50
17	33	33	36	41	47	60	69	64	70	83	83	83	83	82	83	83	81	76	75	61	53	50	41	39	1509	63
18	36	35	49	53	58	65	71	77	78	81	83	84	83	81	80	78	77	77	76	74	70	58	49	49	1622	68
19	50	49	55	62	65	73	76	76	78	74	77	76	68	60	66	67	65	64	60	54	51	48	46	46	1506	63
20	46	46	47	55	64	73	75	75	75	82	87	88	78	75	75	75	68	66	68	62	60	57	56	55	1608	67
21	55	56	56	54	53	54	55	55	55	56	57	57	57	57	60	59	57	57	56	55	52	52	51	50	1326	55
22	49	49	49	49	50	51	55	60	57	56	58	65	64	63	65	60	58	52	49	46	45	44	43	43	1280	53
23	42	41	40	40	40	44	48	46	52	59	65	66	66	65	63	63	62	60	50	46	48	41	37	37	1221	51
24	37	37	38	38	39	39	41	42	42	43	44	51	52	53	54	55	52	51	50	47	43	40	35	34	1057	44
25	35	35	38	44	44	58	58	63	69	71	71	72	70	69	69	68	68	67	62	59	53	41	36	34	1354	56
26	31	30	38	45	49	55	59	64	68	70	72	68	70	66	68	71	68	62	55	55	53	51	49	45	1362	52
27	43	44	45	50	53	54	53	55	57	58	60	66	63	61	60	59	58	57	59	51	49	46	44	43	1288	54
28	41	39	40	40	41	42	41	41	41	93	44	45	46	47	49	47	46	45	45	43	43	42	42	41	1034	43
29	41	41	41	41	42	44	46	48	55	54	55	53	59	53	55	54	51	50	47	44	41	40	37	36	1128	47
30	36	37	37	38	39	40	41	44	49	59	69	65	66	67	66	59	58	56	54	55	45	38	35	38	1191	50
31	37	38	38	41	43	48	62	74	79	78	77	78	78	75	72	68	60	55	53	50	46	45	43	43	1381	58

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Table A-6 Average Black-Bulb Temperature, °F, for Site 4 at 3 inches, August 1952

DATE	FOR HOUR ENDING AT: A.M. 1	2	3	4	5	6	7	8	9	10	11	12N	ALASKAN STANDARD TIME P.M. 1	2	3	4	5	6	7	8	9	10	11	12M	TOTAL	AVE.
1	43	43	43	44	45	48	51	56	57	73	74	80	78	75	73	72	65	61	57	53	50	48	45	41	1375	57
2	42	42	43	45	53	62	57	62	62	65	68	80	73	70	67	65	59	65	56	57	55	55	54	54	1411	59
3	54	53	52	51	53	58	60	56	57	57	55	53	55	53	53	56	59	59	56	51	50	48	44	45	1288	54
4	45	45	46	47	50	52	56	67	67	66	60	61	60	60	62	62	60	57	56	52	49	48	47	45	1320	55
5	45	44	44	44	45	49	63	62	67	71	70	68	67	62	65	66	65	63	62	50	46	42	41	37	1338	56
6	37	31	35	45	48	50	57	64	75	82	86	86	85	83	82	80	78	76	75	73	59	51	49	44	1531	64
7	43	44	46	59	66	70	75	81	82	82	81	81	81	79	78	76	75	73	72	64	52	47	47	43	1597	67
8	40	38	42	52	62	67	75	82	84	86	88	85	85	83	79	75	73	73	67	61	58	54	53	51	1613	67
9	50	44	48	53	66	70	73	80	86	88	89	89	80	77	74	70	59	59	52	52	53	52	51	49	1564	65
10	50	50	50	51	53	58	70	74	81	83	80	77	75	70	65	62	61	65	63	60	53	51	50	51	1503	63
11	47	46	45	45	47	51	55	57	57	60	64	63	60	60	58	59	57	55	53	52	51	50	50	49	1291	54
12	48	48	48	48	48	49	50	52	52	52	52	53	56	58	58	54	53	51	49	48	48	48	47	47	1216	51
13	47	48	48	48	49	51	52	57	57	56	59	62	66	64	64	63	55	50	47	45	44	44	42	43	1244	52
14	42	41	40	40	41	43	44	44	47	45	45	48	51	51	49	49	45	43	39	38	35	34	34	33	981	41
15	33	33	33	33	35	38	47	53	56	65	55	62	58	55	59	55	54	53	52	37	35	37	31	29	1097	46
16	29	27	27	33	41	38	38	43	47	53	60	62	62	61	61	60	59	55	53	43	42	42	42	41	1119	47
17	39	39	39	39	42	46	53	62	69	68	67	67	68	63	60	58	55	50	45	43	41	39	37	36	1229	51
18	35	35	35	35	36	40	43	46	46	49	52	46	47	46	43	41	39	38	37	35	34	33	33	33	957	40
19	32	32	33	33	35	36	40	39	40	43	43	43	43	41	39	37	35	33	32	31	30	30	30	29	899	36
20	29	29	29	29	30	31	33	37	43	41	43	43	43	42	41	41	39	36	33	31	29	28	27	25	832	35
21	25	25	25	25	24	26	30	42	52	54	54	53	50	49	47	47	46	47	40	30	27	27	25	25	895	37
22	25	23	25	24	29	31	31	37	45	46	52	53	53	52	53	56	50	47	39	34	31	30	29	31	924	39
23	33	32	33	35	38	38	44	51	56	60	62	62	56	54	54	52	45	41	37	35	34	33	33	33	1051	44
24	32	31	31	31	30	30	30	30	31	31	33	35	35	35	35	35	34	34	33	32	31	31	31	30	771	32
25	30	30	30	30	31	33	35	37	38	39	41	41	41	41	40	38	37	36	35	34	33	32	31	31	844	35
26	31	31	30	30	35	36	40	46	45	50	55	53	50	48	48	45	42	40	38	35	32	28	26	27	941	39
27	23	22	22	21	31	41	35	52	64	66	65	65	65	65	64	65	64	63	56	36	35	34	33	33	1119	47
28	35	33	30	28	31	42	39	57	64	67	68	67	68	65	66	63	55	54	45	39	38	34	32	32	1150	48
29	32	32	32	32	32	33	36	39	46	49															363	36

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Table A-7 Average Black-Bulb Temperature, °F, for Site 5 at 3 inches June 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
29																	52	48	45	41	39	39	39	38	341	43
30	37	36	35	35	35	36	39	47	57	61	63	65	67	69	69	69	66	60	56	51	46	41	39	38	1216	51

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Table A-7 Average Black-Bulb Temperature, °F, for Site 5 at 3 inches, July 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	37	36	36	36	36	37	38	40	41	44	50	61	72	69	71	73	69	64	59	53	47	41	36	35	1181	49
2	34	33	33	34	36	36	39	43	46	53	58	60	70	80	81	82	80	79	74	67	59	50	43	41	1311	55
3	38	37	35	40	53	66	73	82	86	88	92	88	85	80	71	75	78	72	75	67	63	59	53	52	1608	67
4	51	50	51	51	54	56	58	67	74	79	91	96	101	95	89	72	56	57	61	61	56	58	54	51	1589	66
5	50	49	45	47	60	70	79	82	84	90	93	96	99	98	85	84	88	60	71	71	62	59	57	56	1735	72
6	53	52	51	52	62	64	64	80	83	91	90	96	97	85	74	98	92	78	86	77	69	64	60	55	1773	74
7	54	54	54	54	55	57	63	74	80	89	88	92	90	82	92	81	80	72	69	66	63	61	58	57	1685	70
8	52	52	51	50	50	60	78	74	79	75	73	86	82	87	83	81	83	78	70	62	58	56	51	51	1622	68
9	50	52	52	53	54	57	59	62	72	67	65	64	63	70	70	72	67	63	67	63	59	57	54	50	1462	61
10	50	49	45	42	55	53	66	57	57	69	74	74	80	79	93	73	70	62	61	58	58	55	54	50	1484	62
11	48	48	46	45	53	65	76	79	82	90	93	83	96	98	93	92	83	80	77	70	67	63	58	56	1741	73
12	55	55	55	55	57	60	64	66	74	81	90	97	92	103	83	83	95	91	86	76	69	64	59	58	1768	74
13	57	52	50	57	60	62	66	63	69	83	85	97	94	89	87	86	86	79	75	69	65	62	60	59	1710	71
14	57	55	55	55	55	58	61	64	70	70	65	69	73	69	70	67	65	69	55	51	48	44	42	40	1427	59
15	39	38	37	37	38	39	41	40	43	46	48	62	79	75	75	67	62	55	49	47	45	43	41	41	1186	49
16	40	42	43	45	48	52	58	63	65	75	72	73	75	75	76	73	72	58	53	48	42	39	36	35	1358	57
17	35	36	40	44	58	66	65	71	83	84	90	96	96	99	99	92	82	75	59	54	47	41	41	38	1591	66
18	27	36	41	50	57	66	72	75	80	85	89	91	92	92	91	86	81	76	71	62	54	49	48	49	1630	68
19	47	47	51	54	63	70	73	77	72	78	76	74	61	68	73	72	66	63	56	53	50	47	47	47	1485	62
20	47	47	47	53	60	75	76	79	89	96	102	90	80	89	86	72	67	69	67	61	59	57	57	57	1682	75
21	57	57	56	54	54	56	56	56	57	58	58	59	58	59	61	59	59	58	55	54	53	53	52	51	1351	56
22	51	50	50	51	52	53	58	62	58	58	63	71	68	73	72	63	60	53	50	47	46	45	45	44	1343	56
23	43	43	42	42	41	46	50	47	54	61	71	75	77	79	79	77	73	60	52	47	45	41	37	37	1319	55
24	38	38	39	39	40	40	42	43	43	44	45	51	53	55	56	59	54	53	52	49	43	40	35	36	1087	45
25	36	35	39	41	41	49	54	61	69	72	75	80	85	87	89	89	85	80	65	58	49	41	40	37	1457	61
26	35	31	31	31	37	47	57	66	73	75	78	78	76	71	68	76	68	62	56	55	54	52	50	47	1374	57
27	43	45	46	48	51	54	54	55	57	59	60	67	65	63	62	62	61	60	61	56	51	48	45	44	1317	55
28	43	40	41	41	42	43	43	43	43	45	47	47	49	50	52	50	49	48	47	46	45	44	43	43	1084	45
29	42	42	42	43	44	45	48	49	57	57	57	56	59	60	59	59	55	54	50	48	43	42	40	38	1189	50
30	38	38	39	39	40	41	42	44	49	58	74	73	72	77	74	65	64	65	59	53	49	40	38	39	1270	53
31	41	38	40	41	43	44	50	67	78	83	86	85	91	96	93	76	67	60	56	53	48	46	45	44	1471	61

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Table A-7 Average Black-Bulb Temperature, °F, for Site 5 at 3 inches, August 1952

DATE	FOR HOUR ENDING AT: A.M.												ALASKAN STANDARD TIME P.M.												TOTAL	AVE.
	1	2	3	4	5	6	7	8	9	10	11	12N	1	2	3	4	5	6	7	8	9	10	11	12M		
1	44	44	44	44	45	46	50	53	58	60	75	85	97	93	85	91	85	70	63	59	54	52	49	45	1491	62
2	43	44	44	45	45	50	61	58	64	64	65	67	85	76	67	67	63	60	63	56	57	56	55	55	1410	59
3	55	54	53	52	52	54	57	57	58	58	57	54	55	55	53	55	60	61	60	57	49	47	45	46	1304	54
4	46	46	47	47	49	54	57	64	72	73	68	67	67	63	64	65	62	63	59	57	52	50	49	47	1398	58
5	46	46	45	45	46	49	56	63	66	77	77	79	79	80	73	82	78	67	62	57	48	45	44	42	1452	61
6	39	37	33	37	44	49	55	66	68	80	94	97	102	103	103	100	95	87	80	73	61	55	53	51	1662	69
7	45	46	44	45	47	54	70	81	88	86	88	90	92	96	97	93	87	78	71	67	55	50	49	49	1668	70
8	41	40	40	40	44	50	65	79	88	91	96	101	103	105	104	86	74	72	73	67	60	58	53	53	1683	70
9	50	49	45	45	46	53	64	72	81	66	90	100	110	98	93	82	71	60	53	52	53	55	53	53	1614	67
10	51	51	51	51	52	56	61	68	74	81	92	92	84	81	71	65	63	69	66	60	53	53	52	52	1549	65
11	52	48	47	47	47	49	52	56	56	56	60	61	63	62	60	60	60	60	57	55	53	53	51	51	1316	55
12	51	50	49	49	49	50	51	51	53	53	53	53	54	56	58	60	56	55	53	51	49	49	50	49	1253	52
13	48	49	49	49	49	50	51	52	57	58	57	63	63	69	65	66	62	52	49	48	46	45	45	44	1286	54
14	44	43	42	41	41	42	44	45	45	47	46	46	50	53	57	53	52	48	45	40	39	36	36	35	1070	45
15	35	34	34	34	34	35	39	49	57	54	72	70	74	78	64	80	70	63	55	49	41	37	36	36	1230	51
16	31	30	29	29	29	33	40	40	44	50	58	72	80	88	87	84	76	67	55	51	45	43	43	44	1248	52
17	42	41	40	40	40	41	46	51	59	73	75	79	84	86	88	64	62	62	53	49	45	42	41	40	1343	56
18	36	37	36	36	36	37	39	44	47	50	49	54	54	49	49	48	45	43	41	39	38	37	35	35	1016	42
19	34	34	34	34	35	36	38	40	43	42	43	47	47	47	47	44	41	39	37	35	34	33	32	32	928	39
20	31	31	31	30	31	32	32	34	36	39	49	45	50	48	47	44	43	40	37	35	32	30	29	27	885	37
21	27	26	26	26	27	28	29	33	42	60	63	67	68	69	69	67	62	54	47	35	29	27	27	26	1034	43
22	26	27	23	25	25	31	32	35	42	51	52	62	65	74	71	71	69	62	48	40	37	33	31	31	1063	44
23	32	34	33	35	36	38	39	44	54	60	66	71	72	65	57	60	57	50	43	39	37	35	35	34	1126	47
24	24	34	33	33	32	32	32	32	32	32	33	35	36	38	38	37	37	36	36	35	34	33	33	32	819	34
25	32	32	32	32	33	33	34	37	39	41	42	43	46	46	45	45	43	40	39	37	36	35	34	34	910	38
26	33	33	33	32	32	33	37	39	44	50	49	61	65	61	58	58	48	44	43	39	35	33	29	28	1017	42
27	25	24	23	23	22	24	35	45	55	65	70	75	83	87	89	89	82	70	64	49	40	37	36	35	1247	52
28	34	35	34	30	29	29	38	47	59	62	65	70	74	75	72	75	74	62	58	45	39	36	35	33	1210	50
29	33	34	34	34	33	36	38	41	50	53															386	39

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Table A-8

Average Black-Bulb Temperature, °F, by Weeks

	Umiat Base	Site 1	Site 2	Site 3	Site 4	Site 5
June 29 - July 5, 1952	57	55	55	54	56	58
July 6 - 12	68	66	64	67	67	69
July 13 - 19	62	60	58	62	60	62
July 20 - 26	57	55	55	58	55	57
July 27 - Aug 2	55	52	52	56	53	55
Aug 3 - 9	63	62	60	65	61	64
Aug 10-16	53	51	50	55	51	53
Aug 17 - 23	43	42	42	43	40	44
Aug 24 - 30	42*	42*	41*	44*	40*	43*
Aug 31 - Sept 6	35					
Sept 7 - 13	31					
Sept 14 - 20	31					
Sept 21 - Sept 27	29					
Mean June 29 - Aug 28	56	54	53	56	54	56

* Ending Aug 28